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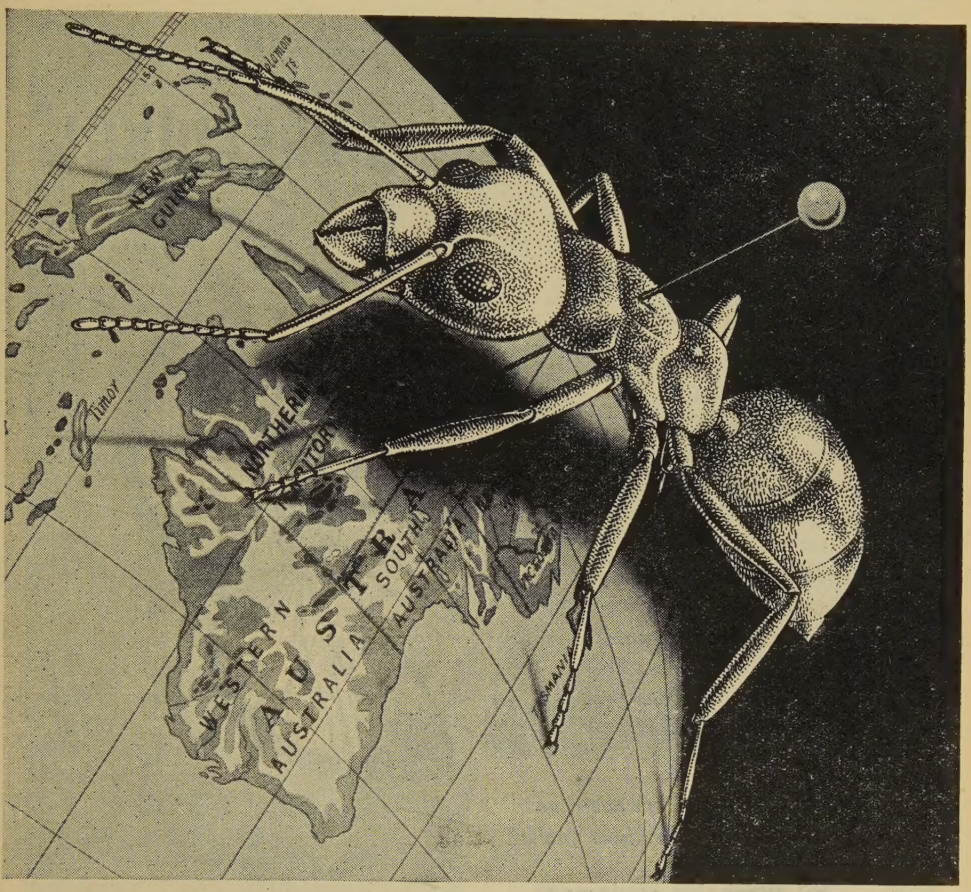


# The case of *Iridomyrmex humilis* . . .

In the past few years many Australian towns, especially in Western Australia and Victoria, have been increasingly plagued by Argentine ants. No jam pot or sugar bowl has been safe — wherever any sweet substance has been exposed the ants have congregated and made life miserable for everyone. The invaders were first identified in Australia in 1939 and have since become an unmitigated nuisance in some built-up areas.

The private wars waged on them by householders have now been superseded by organised campaigns of eradication. The insecticide finally chosen to wipe out the Argentine ant is dieldrin, recently developed by Shell. Dieldrin's greater potency and persistence make it ideal for open grid spraying, the method adopted. Infested areas are divided by spray bands into smaller units and the ants, including the foraging queens, must cross these insecticidal barriers sooner or later in their quest for food.

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(1930) [A]

Ellis (P. E.). **Social Aggregation and gregarious Behaviour in Hoppers of** *Locusta migratoria migratorioides* **(R. & F.).**—*Behaviour* **5** no. 3 pp. 225–260, 10 figs., 24 refs. Leiden, 1953. (With a Summary in French.)

The following is taken from the author's summary. When locust populations are low, individual hoppers rarely meet others of their own species, for which it has been suggested that they have no strong attraction, though such an attraction may develop if the hoppers are forcibly crowded. In the study described, the behaviour of hoppers of *Locusta migratoria migratorioides* (R. & F.) reared in crowds was compared with that of hoppers reared in isolation. Two experimental techniques were used. In the first, the floor of a ring-shaped cage illuminated from above was divided by pencil marks into equal segments. Some 15 hoppers were introduced, and, after these had settled down, the number per segment was counted and the data tested for randomness by comparison with a Poisson series. The numbers of hoppers in groups were analysed in the usual way. The proportion of hoppers that aggregated socially was found to depend on rearing conditions, the percentage being significantly greater (50–75) for second-instar hoppers reared in crowds than for those reared in isolation (30–45), and hoppers reared in isolation aggregated more than nymphs of the grasshoppers, *Anacridium aegyptium* (L.) and *Cyrtacanthacris tatarica* (L.) (20–45 per cent.). Social aggregation would, therefore, appear to be a specific characteristic of *L. m. migratorioides* and to become greatly intensified as a result of crowding. In second-instar hoppers, the colour of the individual at hatching and the parental rearing conditions did not appear to affect the proportion showing social aggregation, although there was evidence that these factors had some effect on behaviour in the first instar.

When formerly isolated hoppers were crowded, a considerable increase in the numbers showing social aggregation took place after 24 hours, and social aggregation four days later was the same in these hoppers as in those that had been crowded from hatching. On the other hand, when formerly crowded hoppers were isolated for as long as eight days, there was only a small reduction in the number aggregating. The hoppers, therefore, rapidly become conditioned to one another as a result of forced crowding, but such conditioning is less easily lost. Newly hatched hoppers did not aggregate, even when crowded, but their behaviour changed very suddenly on the second or third day, suggesting a necessity to await the maturation of sense organs or parts of the nervous system involved in hopper interactions. Social aggregation, even in crowded hoppers, was sometimes influenced by environmental factors. Interactions leading to aggregation were equally well shown at air temperatures ranging from 24 to 35°C. [75·2 to 95°F.], but were reduced at very high temperatures, in very dry air, in the absence of radiant heat or in the absence of light.

In the second technique, individual hoppers were offered a choice of three decoys (three tethered live hoppers, three pieces of white fibre board and three pieces of black fibre board) evenly spaced in a circular cage illuminated from above. The numbers of times that hoppers settled in each third of the cage and within two hopper lengths of (aggregated with) each decoy were counted and compared with the chance expectations. Both measures of behaviour gave similar results. Hoppers crowded from hatching or for only four days aggregated in over 50 per cent. of cases and always preferred the live-hopper decoy. Hoppers reared in isolation aggregated in less than 45 per cent. of cases and always preferred the black inanimate decoy. When formerly crowded hoppers were isolated, they still showed a preference (although a reduced one) for tethered-hopper decoys.

(1930) Wt. P8522/3895 10/55 E.P. Ltd. Gp. 566 [A] 

Hoyle (G.). **Changes in the Blood Potassium Concentration of the African Migratory Locust** (*Locusta migratoria migratorioides* **R. & F.) during Food Deprivation, and the Effect on neuromuscular Activity.**—*J. exp. Biol.* **31** no. 2 pp. 260–270, 3 figs., 11 refs. London, 1954.

The following is the author's summary. The concentrations of sodium and potassium in the haemolymph of the locust *Locusta migratoria migratorioides* (R. & F.) have been determined by flame photometry. The molar ratio of sodium to potassium is normally about 5:1. During a short period of starvation the potassium content of the haemolymph decreases by as much as 50 per cent. The change in potassium is adequate to account for observed differences in muscle membrane resting potentials and for variations in the mechanical responses of the muscles to nerve stimulation. The ability of fifth-instar hoppers to respond to stimulation by hopping or jumping is increased after a short period of starvation owing to the increased mechanical responses of the muscles. It is suggested that changes in diet potassium will be found to influence behaviour of locusts by the direct effect of the potassium on muscle fibre activity.

Ellis (P. E.) & Hoyle (G.). **A physiological Interpretation of the Marching of Hoppers of the African Migratory Locust** (*Locusta migratoria migratorioides* **R. & F.**).—*J. exp. Biol.* **31** no. 2 pp. 271–279, 2 figs., 11 refs. London, 1954.

The following is virtually the authors' summary. Hoppers of *Locusta migratoria migratorioides* (R. & F.) that have been reared in crowds exhibit characteristic marching behaviour in the laboratory in foodless cages under standard conditions. The rate of attainment of maximum marching by a given group of hoppers is greatest following a short period of starvation immediately preceding transfer to these conditions. A meal of filter-paper soaked in sugar solution exerts no retarding effect on the rate of attainment of full marching, whilst if an adequate concentration of potassium salt is added, a definite retardation is observed. In locusts actively feeding on grass, the potassium content of the blood is relatively high, and it is suggested that this causes a reduced muscular efficiency that may explain retardation in attainment of full marching [*cf.* preceding abstract]. The marching pattern is the result of the activity of particular nerve centres that require a period of activation by a combination of factors before full expression is achieved. Two final factors are essential for the maintenance of the marching state: a low concentration of blood potassium and mutual stimulation by other marching hoppers.

Kozhanchikov (I. V.). **Peculiarities of the Hibernation and Diapause of the Asiatic Locust** (*Locusta migratoria* **L.**) **and certain other Acrididae.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **96** no. 2 pp. 407–409, 1 graph, 10 refs. Moscow, 1954.

Investigations were carried out in the Soviet Union for six years, from 1947 to 1953, on the diapause of the eggs of *Locusta migratoria* (L.) and for two on that of four other Acridids, *Calliptamus italicus* (L.), *Oedaleus decorus* (Germ.), *Chorthippus albomarginatus* (Deg.) and *Omocestus viridulus* (L.). The eggs in each series, which were laid over periods of at most 2–3 weeks, were kept for a month in damp soil at 20–22°C. [68–71·6°F.], to complete their early development, and were then transferred to oven-dried sand in glass containers in which they were kept at 20°C. for another two months. The containers were then placed in a refrigerator at a

temperature of 4–0°C. [39·2–32°F.]. Samples of 200–300 eggs were taken two months after oviposition and thereafter twice a month and placed in damp sand with a temperature of 25–26°C. [77–78·8°F.] to provide optimum conditions for hatching. The results showed that eggs of all five species survived under winter conditions for up to 1½ years and are able to overwinter once only. Those for *L. migratoria* in 1950–52 are shown in detail in a table. Eggs transferred to hatching conditions 60 days after deposition hatched in an average of 71·5 days, but mortality reached 90·5 per cent., indicating that exposure to cold is not essential for ending the diapause, though development without it is slow. This may explain the occurrence of only two generations of *L. migratoria* a year in tropical Africa and of only one and a partial second in some years in Central Asia. Eggs transferred after 20 days' exposure to cold hatched in the almost normal period of 17·8 days. Mortality was then 63·5 per cent., but fell to 30·7 and 14·7 per cent. (the normal level) after 23 and 43 days' exposure to cold, respectively. Mortality rose again after 361 days' cold, though the hatching periods remained short, and reached 89·5 per cent. after 388 days, 98·4 after 408 and 100 after 440 and 502 days.

These results are compared with those obtained for the eggs of *Lymantria dispar* (L.) [*cf. R.A.E.*, A **40** 221]. The latter cannot survive winter conditions for so long, and, unlike the locust eggs, do not require moisture for hatching. Although the locust eggs in diapause absorb water this does not terminate the condition, eggs transferred from dry to damp sand becoming three to four times as heavy but remaining in diapause.

Rudnev (D. F.) & Grimal'skiĭ (V. I.). **The Toxicity of Hexachlorane as a Fumigant to Melolonthid Larvae.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **97** no. 3 pp. 551–554, 1 fig., 5 refs. Moscow, 1954.

Excellent protection of forest-tree seedlings from Lamellicorn larvae has been obtained in the Soviet Union by dusting the roots before planting with DDT or BHC. This method requires less labour and material than introducing the toxicant into the soil in closely spaced holes, but it is sometimes harmful to plants set in dry soil, especially in the southern regions, and renders them susceptible to drought. Tests were therefore carried out in 1951 in the Province of Kiev to investigate the effectiveness of BHC as a fumigant against the larvae, so that direct contact of the dust with the roots might be eliminated.

Small wire cages containing soil, larvae of *Anoxia pilosa* (F.) and *Polyphylla fullo* (L.) and a slice of potato as food were arranged in sandy soil so as to radiate horizontally, vertically downwards and diagonally downwards from muslin bags containing 5 or 10 gm. 12 per cent. BHC dust placed at a depth of 4 ins.. or horizontally, vertically upwards and diagonally upwards from bags containing 10 gm. placed at a depth of 16 ins. The weather was dry and hot, the air temperature reaching 36°C. [96·8°F.] in the shade and the temperature on the surface of the soil ranging up to 56°C. [132·8°F.]. The cages were examined at ten-day intervals, and the dead larvae were replaced by living ones and the BHC dust changed before they were returned. Mortality in the cages next to the bags averaged 70·9 per cent. for 5 gm. dust and 60·6 per cent. for 10 gm. at a depth of 4 ins., as compared with 10·4 per cent. in the controls, and 22·2 per cent. for 10 gm. dust at a depth of 16 ins., as compared with 5·6 per cent. Effectiveness decreased, though irregularly, with increased distance from the bags and was still perceptible at a distance of 12 ins. in the case of those 4 ins. deep.

Since soil temperature appeared to be a significant factor in these results, a similar test was carried out in 1952 in which it was measured continuously.

Second-year larvae of *Melolontha melolontha* (L.) (*vulgaris* F.) that had just moulted were used, and the dust was introduced to a depth of 10 ins. in a shady plot and to depths of 2 and 10 ins. in an open one. The average and maximum soil temperatures were 19·1 and 20·3°C. [66·38 and 68·54°F.], respectively, at a depth of 10 ins. in the first, and 25·1 and 31·1°C. [77·18 and 87·98°F.] at a depth of 2 ins. and 18·7 and 21·2°C. [65·66 and 70·16°F.] at 10 ins. in the second. Examination of the cages in the shaded plot showed that BHC had no effect on the larvae whatever during the 10–13 days of the exposure, all feeding normally. In the open plot, only larvae in the two nearest cages in the horizontal row at a depth of 2 ins. were killed, all the others surviving. It is concluded that an average daily temperature of at least 25°C. [77°F.] is required for effective fumigant action, and this was confirmed in a laboratory test in which four cages were arranged in an 8-in. row at a depth of 2 ins. in sand, 5 gm. 12 per cent. BHC being placed at one end. When the temperature of the sand was 25°C., the larvae in the nearest cage died in 3–7 days, and the others survived. When it was 30°C. [86°F.], the larvae in the two nearest cages died, and those in the third and fourth ceased to feed, and when it was 35°C. [95°F.], the larvae in the nearest cage died on the second day and those in the others on the third, fourth and fifth. It is concluded that the larvae could be controlled by protective zones of BHC near the plants.

Pavlov (A. N.). **The Extent of the Infestation of the Grains of Wheat by Little Tortoise Bugs (*Eurygaster*, Pentatomidae) under irrigated Conditions.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **98** no. 4 pp. 661–663, 1 graph, 6 refs. Moscow, 1954.

Observations during an outbreak of Pentatomids of the genera *Eurygaster* and *Aelia* on wheat in the Province of Saratov in 1953 showed that only 10 per cent. of the grains were attacked in an irrigated plot, the number of punctures per grain not exceeding two, whereas 41 per cent. were attacked on a non-irrigated one and the number of punctures per grain ranged up to ten. Damaged grain from the non-irrigated plot contained less total and albuminous nitrogen than the undamaged grain, whereas no such difference occurred on the irrigated plot, probably because the injury was less. The content of non-albuminous nitrogen in punctured grains increased on both plots.

The greater infestation of the grain on the non-irrigated plot may have been due to a more favourable microclimate for the bugs, since the season was wet, to the lower yield of the plants, which would lead to increased damage, or to reduced succulence of the grains, which would lead to more frequent punctures, and it is concluded that irrigation, besides increasing the yield of grain, affords some protection from Pentatomids [*cf. R.A.E.*, A **40** 310–311].

Day (M. F.) & Bennetts (M. J.). **A Review of Problems of Specificity in Arthropod Vectors of Plant and Animal Viruses.**—[3 + ] 172 pp., 4 figs., 52 pp. refs., multigraph. Canberra, Div. Ent., Commonw. sci. industr. Res. Org. Aust., 1954.

The study of arthropod vectors of virus and rickettsial diseases has provided increasing evidence that any one pathogen can be transmitted by more than one species, and the question arises how many pathogens now thought to be transmitted by a specific vector or restricted group will eventually be shown to be transmitted also by others. A pathogen transmitted by several vectors may be specific to a group similar in crucial aspects of physiology

and biochemistry, and can therefore be considered in a study of vector specificity. Investigation of the reasons for the failure to transmit of arthropods thought likely to serve as vectors may also yield useful information, even though no solution to many of the problems can be suggested on the basis of available information.

In this review, the problem of the causes of vector specificity is approached from the aspect of insect physiology, both plant and animal viruses are considered, and rickettsiae are also included because they seem in certain respects to form an almost continuous series with the larger animal viruses. The data on which it is based are summarised in an appendix (pp. 23–110) that contains a list of 78 plant viruses, 9 rickettsiae and 28 animal viruses, including representatives of all types of virus-vector relationship. The information for the plant viruses comprises lists of vectors and non-vectors and notes on such points as the acquisition of the virus by and its viability in the vector, latent period, multiplication of the virus in the vector, and other methods of transmission, and the authority is cited in every case, with the appropriate reference to the extensive bibliography (pp. 111–163). There is also an index to the viruses and rickettsiae.

It is clear from the data in the appendix that the concept of vector specificity is a relative one, the range extending from diseases such as potato spindle tuber, which is transmitted by both Aphids and chewing insects [*R.A.E.*, A **15** 509; **16** 388; **18** 220], to beet curly top, which is transmitted only by *Circulifer tenellus* (Baker), though it survives in various other arthropods [*cf.* **26** 445]. An interesting case is that of tomato spotted wilt, sugar-cane Fiji disease and winter-wheat mosaic, in which the viruses can be acquired by the vectors only in the nymphal stage [**20** 212; **21** 520; **30** 581]. The difficulty of deciding on the ability of the vectors to transmit is illustrated by instances in which the same arthropod has been found by one author to transmit and by another to be incapable of transmitting. It is clear that specificity is not necessarily an attribute of a species of arthropod, and it may be restricted to genetically distinct vector strains [*cf.* **20** 717]. No information is available as to the causes of specificity in many cases, but sufficient is known in some to indicate where in the transmission cycle a barrier to successful transmission might be expected. The problems of transmission are undoubtedly more complex in viruses that multiply in their vectors than in those that do not, and the causes of specificity are likewise more involved. Among the known causes are feeding behaviour (including preferred tissues and the amount of feeding on the viruliferous or susceptible host), inhibitors in gut or salivary secretions, and occurrence of regurgitation. For viruses with a latent period in their vectors, additional barriers may include mid-gut and salivary-gland permeability and blood inhibitors. In addition, there are the factors of innate and humoral immunity, which have received scant experimental study in insects. Tissue specificity and gut permeability have both been found to be significant contributors to the specificity of insect vectors, but conclusions regarding their relative importance and the place of other barriers may be altered with increasing knowledge.

Bradley (R. H. E.). **Studies of the Mechanism of Transmission of Potato Virus Y by the Green Peach Aphid, *Myzus persicae* (Sulz.) (Homoptera: Aphidae).**—*Canad. J. Zool.* **32** no. 2 pp. 64–73, 1 graph, 15 refs. Ottawa, 1954.

The following is largely the author's summary of this account of the experiments described, in which apterous adults of *Myzus persicae* (Sulz.) were used to transmit potato virus Y to and from tobacco in the greenhouse

[*cf. R.A.E.*, A **43** 133]. The Aphids ceased to be infective usually within minutes and always within hours after leaving the infected plants, the time being longer when they were prevented from feeding than when they fed. Aphids that were prevented from feeding remained infective for longer at 2°C. [35·6°F.] than at 35°C. [95°F.]. After 1–4 hours without food, over 80 per cent. made initial acts of probing, referred to as feeding punctures [*cf.* **40** 187], that lasted less than a minute, and about 70 per cent. of these Aphids transmitted the virus after one such feeding puncture on an infected plant. Though virus was acquired by Aphids during feeding punctures as brief as five seconds, those that made feeding punctures lasting 11–60 seconds were the most likely to become infective. The percentage of Aphids that transmitted the virus decreased when the stylets were inserted into infected plants for over a minute, and none of the Aphids transmitted the virus after the stylets had been inserted into it for over 20 minutes. The highest percentage of Aphids transmitted the virus when they were transferred to test plants immediately after a single brief feeding puncture on an infected plant. The percentage of Aphids that transmitted the virus decreased when they spent ten minutes or longer on infected plants; also, the probability of their becoming infective during a single feeding puncture decreased by about one-third during the first ten minutes of feeding after 1–4 hours without food. Even when conditions were suitable, about 25 per cent. failed to transmit, yet those that failed transmitted as readily in a second trial as those that transmitted in the first.

In a discussion of these results, it is concluded that *M. persicae* acquires virus Y from the epidermis of the leaf [*cf.* **43** 129]. During feeding, the stylets penetrate into the phloem and are surrounded by a tubular salivary sheath, but little saliva is produced during feeding punctures. It is therefore possible that the sheath in some way prevents the acquisition of the virus.

Lalonde (D. I. V.) & Brown (A. W. A.). **The Effect of Insecticides on the Action Potentials of Insect Nerve.**—*Canad. J. Zool.* **32** no. 2 pp. 74–81, 3 pls., 9 refs. Ottawa, 1954.

The following is virtually the authors' summary. Solutions of 17 insecticides in maize oil were applied to the leg of *Periplaneta americana* (L.), and their effect on the sensory impulses of the crural nerve was determined by means of a preamplifier and cathode-ray oscillograph. DDT, methoxy-DDT (methoxychlor) and DDD induced well-marked trains of repetitive discharge. Aldrin and dieldrin evoked low-voltage trains of repetitive discharge after a latent period of two to four hours. Technical chlordane, heptachlor, α-chlordane, β-chlordane, and toxaphene all showed considerable latent periods before stimulating the action potentials. Lindane [γ BHC] rapidly induced the appearance of tiny sets of repeat spikes. The pyrethrins increased the frequence of impulses, while DNC and dinex increased both the voltage and the frequency. Schradan showed no effect, TEPP [tetraethyl pyrophosphate] caused a transient stimulation, and parathion induced trains of repetitive discharge after a latent period of three hours.

Bird (F. T.) & Whalen (M. M.). **A nuclear and a cytoplasmic polyhedral Virus Disease of the Spruce Budworm.**—*Canad. J. Zool.* **32** no. 2 pp. 82–86, 3 pls., 18 refs. Ottawa, 1954.

The following is almost entirely the authors' summary. Studies in Canada showed that larvae of *Choristoneura fumiferana* (Clem.) are

susceptible to two polyhedral virus diseases. The first [*R.A.E.*, A **40** 159] is characterised by the formation of polyhedra within the nuclei of the tracheal matrix, fat, blood and hypodermal cells. The polyhedra contain mostly rod-shaped particles 260 × 28 mμ in dimensions. The second is a new type and is characterised by the formation of polyhedra in the cytoplasm of mid-gut cells. The polyhedra contain only spherical particles from 28 to 80 mμ in diameter. Both diseases occurred in the same insect, but it was possible to separate the cytoplasmic disease from the nuclear disease by extracting groups of the cytoplasmic polyhedra from the mid-gut with a micro-manipulator before the nuclear disease developed. The two diseases were not found occurring together in the field. Examination of sections from 1,088 field-collected larvae showed that 1·1 per cent. were infected with the cytoplasmic disease; none was infected with the nuclear disease.

Stark (R. W.). **Distribution and Life History of the Lodgepole Needle Miner** (*Recurvaria* **sp.**) (**Lepidoptera: Gelechiidae**) **in Canadian Rocky Mountain Parks.**—*Canad. Ent.* **86** no. 1 pp. 1–12, 15 figs., 35 refs. Ottawa, 1954.

It is stated in a footnote to this paper that some doubt exists as to the specific identity of the Gelechiid that attacks lodgepole pine (*Pinus contorta* var. *latifolia*) in western Canada and has hitherto been recorded as *Recurvaria milleri* Busck [*cf. R.A.E.*, A **35** 59; **40** 377, 380; **42** 27]. It is therefore referred to as *Recurvaria* sp. Accounts, based on the literature, are given of the history of its occurrence in Canada, its present distribution there in the Banff, Yoho, Kootenay and Jasper national parks, and its bionomics, with descriptions of all stages.

The eggs are laid in mined needles, less frequently in or near the needle sheath, and occasionally in other situations, and field observations indicated that they hatch in 15 days; during unfavourable weather, the egg stage lasted up to 45 days, but over 90 per cent. of the eggs eventually hatched. The larvae appear in August, and their seasonal development is described. In general, they mine the needles of the previous year's growth, but are less discriminating in the later instars than in the early ones. Each larva feeds in three needles during its development, but only the last two are completely mined. Transference from one needle to another takes place after the first winter, at the end of the second instar (June), or, more usually, at the beginning of the third (July), and again at the end of the fourth or the beginning of the fifth instar, during the last two weeks of the following May. The pupal stage lasts 3–4 weeks, and adult emergence begins in the first week of July.

The threshold of activity for newly hatched larvae is between 59 and 65°F. In 1951, when cold, wet weather preceded transference to the second needle, this operation, which is normally completed by the whole population in 2–3 weeks, continued throughout July and the first two weeks of August. Larval feeding ceases about October, when maximum temperatures are below 45°F. and minimum temperatures rarely rise above 32°F., and is resumed in spring when these temperatures are exceeded. Diapause is not obligatory, and is readily terminated by exposing larvae to temperatures above the threshold. Exposure for more than 24 hours to temperatures below 0°F. caused 50 per cent. mortality among young larvae, but third- and fourth-instar larvae in diapause survived exposure to −30°F. for at least that period in autumn.

Experiments on chemical control have had little success; only the adults and larvae migrating from one needle to another are vulnerable, and operations against them seem impracticable. Attempts at biological control [*cf.*

**40** 378] show some promise. Winter cold is normally responsible for about 35 per cent. mortality of the larvae and killed 90–100 per cent. of them at the lower altitudes in the Banff national park, Alberta, in 1949–50 [*cf.* next abstract].

Henson (W. R.), Stark (R. W.) & Wellington (W. G.). **Effects of the Weather of the Coldest Month on Winter Mortality of the Lodgepole Needle Miner, *Recurvaria* sp., in Banff National Park.**—*Canad. Ent.* **86** no. 1 pp. 13–19, 1 fig., 2 refs. Ottawa, 1954.

The following are almost entirely the authors' conclusions from a study of the relation between winter mortality of larvae of *Recurvaria* sp. on lodgepole pine [*Pinus contorta*] [*cf.* preceding abstract] in the Bow Valley of the Banff national park, Alberta, and the meteorological conditions that prevail there, based on data for 1948–49 and 1949–50. In the main part of the Valley, the vertical distribution of temperature is a function of the predominant type of general air circulation. During a month characterised by frequent, but rapid, invasions of polar continental air, the upper slopes are more often colder than the valley floor. Stagnating air of any type produces extremes of cold on the valley floor, and these are much more severe when the air is of polar continental origin. Invading maritime air warms the upper slopes, so that the valley bottom is colder than the upper slopes at such times and effects are produced that are similar to, but more moderate than, those of stagnating polar continental air.

Winter mortality of the larvae seems to be distributed in the same way as the zones of extreme cold that occur during the coldest winter month. Because the dominant type of circulation during this month may differ in different years, the zone of most extreme cold may occur either at valley bottom or at the tops of the slopes. Consequently, greatest mortality should occur in either of these situations, although it should occasionally be exceptionally great at valley bottom. Best survival should occur most consistently along the middle of the slopes. This middle zone should constitute the most persistent reservoir for re-infestation of the other zones and, therefore, the attempts to control the insect should be concentrated in it. The air flow is more complicated in or near the major passes that enter the Valley from the west, and the vertical distribution of mortality is much less predictable than in the rest of the Valley.

Arthur (A. P.). **A plastic Cage for rearing small Parasites.**—*Canad. Ent.* **86** no. 1 pp. 33–35, 1 fig. Ottawa, 1954.

A description is given of a rearing cage that proved useful for studies of *Zagrammosoma americanum* Gir. and other small parasites in Ontario. It measures 4 × 2 × 1 ins. and is constructed entirely of a transparent plastic material (Lucite) 1/16 in. in thickness, the parts being assembled with ethylene dichloride as a solvent. The front consists of a panel that slides vertically, and food and host material can be introduced without disturbing the parasites, since no extra light enters when it is raised. Three circular holes covered with silk bolting cloth in each of the long sides enable the interior to be sprayed with water. The size and transparency of the cage permit its occupants to be examined microscopically without removing them from it.

McGuffin (W. C.). **Descriptions of Larvae of Forest Insects:** *Syngrapha, Autographa* **(Lepidoptera: Phalaenidae).**—*Canad. Ent.* **86** no. 1 pp. 36–39, 6 figs., 6 refs. Ottawa, 1954.

The larvae described in this part of a series on Canadian forest insects [*cf. R.A.E.*, A **39** 216] are those of *Syngrapha selecta* (Wlk.), *S. alias* (Ottolengui) [*cf.* **30** 586], *S. celsa* (Hy. Edw.), *S. epigaea* (Grote) and *Autographa ampla* (Wlk.). The first three feed on conifers, and the last two attack deciduous trees and shrubs. A key to the mature larvae is included.

Dondale (C. D.). **Biology of** *Agathis laticinctus* **(Cress.) (Hymenoptera: Braconidae), a Parasite of the Eye-spotted Bud Moth, in Nova Scotia.** —*Canad. Ent.* **86** no. 1 pp. 40–44, 7 figs., 9 refs. Ottawa, 1954.

The bionomics of *Agathis laticincta* (Cress.), which parasitises *Spilonota ocellana* (Schiff.) in orchards in Nova Scotia, were investigated during 1947–50. It was found that the eggs were laid during the latter half of July and the first half of August on the ganglia of the ventral nerve cord in *Spilonota* larvae in the first and second instars, usually at the rate of one per larva. The parasite hatched within about a week and floated freely in the haemocoel of the host. By early September, all had assumed the distinctive overwintering form, but were still in the first instar. Growth was resumed in the following May, two or more weeks after the host larvae had entered the buds. The parasites at first fed slowly and on non-vital structures, so that the hosts were able to spin shelters in late June or July, but they then fed more rapidly and finally left their hosts and fed externally on their fluid contents, thus causing death. Pupation occurred in the host shelters, and adult emergence began 10–14 days later and usually reached a peak during the last two weeks of July, when young larvae of *Spilonota* were present. Males slightly predominated in the laboratory, where adults provided with a solution of 25 per cent. cane sugar survived for at least a week. Planidium-like hyperparasites were found in a few first-instar larvae of *A. laticincta*, and the full-fed larvae were parasitised by the Ichneumonid, *Ephialtes* (*Scambus*) *hispae* (Harris), which also attacks larvae of *S. ocellana*.

Morrison (P. E.) & Brown (A. W. A.). **The Effects of Insecticides on Cytochrome Oxidase obtained from the American Cockroach.**—*J. econ. Ent.* **47** no. 5 pp. 723–730, 9 graphs, 23 refs. Menasha, Wis., 1954.

The following is based almost entirely on the authors' introduction and summary. Organic insecticides have been shown to have various and characteristic effects on the rate of oxygen consumption of the German cockroach [*Blattella germanica* (L.)] [*R.A.E.*, A **40** 160], DNC has been found to stimulate the respiratory enzyme, cytochrome oxidase, in embryo grasshoppers, and Sacktor showed that DDT and methoxy-DDT (methoxychlor) partly inhibit the cytochrome oxidase of the house-fly [*Musca domestica* L.] and further suggested that resistance to DDT in strains of this fly may be at least partly due to an increased content of the enzyme [B **39** 118; **40** 135].

In the investigations described, the effect of 26 insecticides on the cytochrome c oxidase of coxal muscle tissue from males of *Periplaneta americana* (L.) was ascertained by a manometric method, using phosphate buffer in the enzyme digest. All the insecticides were at molar concentrations of $1 \times 10^{-3}$ and $1 \times 10^{-5}$, except the extracts of ryania and sabadilla,

which were at the higher concentration only. All the chlorinated hydrocarbons tested completely inhibited the cytochrome c oxidase at the higher concentration, and caused a slight transient stimulation at the lower one. The inhibition at the higher concentration was rapid in the case of p,p′DDD, p,p′methoxy-DDT, γ BHC and toxaphene, but slower in onset with p,p′-DDT, aldrin, dieldrin, heptachlor and the α and β isomers of chlordane. DNC, dinex and dinoseb stimulated the oxidase at the lower concentration, and the last two inhibited it at the higher one. Of the organic phosphates, TEPP [tetraethyl pyrophosphate] was significantly stimulatory at the higher concentration and schradan slightly so, whereas parathion and malathion caused complete inhibition; all four, especially malathion and TEPP, were stimulatory at the lower concentration. Nicotine stimulated at both concentrations, and rotenone at the lower one, whereas at the higher concentration the pyrethrins and allethrin completely inhibited and rotenone, ryania and sabadilla were weak inhibitors. Phenothiazine and two thiocyanate preparations (Lethane 60 and Lethane 384) markedly inhibited at the higher concentration.

GARMAN (P.). **Spray Combinations for Control of Apple Pests in Connecticut.** —*J. econ. Ent.* **47** no. 5 pp. 731–734. Menasha, Wis., 1954.

In the tests described, apple trees in an orchard in Connecticut were sprayed in 1952 and 1953 with various combinations of insecticides and fungicides and the effect of these on populations of insects and mites and on the chemical composition and flavour of the fruit was investigated. The insecticides were lead arsenate, 1189 (2,3,3a,4,5,6,7,7a,8,8-decachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene-1-one), p,p′methoxy-DDT (methoxychlor) alone or with DDD (TDE), CS-708 [1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] with DDD, and Black Leaf 253 (DDT and parathion). The chlorinated hydrocarbons were more effective than lead arsenate against the plum curculio [*Conotrachelus nenuphar* (Hbst.)], except for the mixtures containing CS-708, which was probably used at too low a concentration, and also against the European apple sawfly [*Hoplocampa testudinea* (Klug)] and the leafhoppers, *Typhlocyba pomaria* McAtee and *Orientus ishidae* (Mats.), and slightly so against the codling moth [*Cydia pomonella* (L.)] and the apple maggot [*Rhagoletis pomonella* (Walsh)], but all of them increased populations of the apple aphid [*Aphis pomi* Deg.], the woolly apple aphid [*Eriosoma lanigerum* (Hsm.)], the European red mite [*Paratetranychus pilosus* (C. & F.)] and the two-spotted mite [*Tetranychus bimaculatus* Harvey]. Black Leaf 253 controlled the rosy apple aphid [*Anuraphis roseus* Baker] and was the most effective material against *Aphis pomi*. Counts of predators of the mites showed that lead arsenate with captan [N-trichloromethyl thiotetrahydrophthalimide] was the least destructive and methoxy-DDT with DDD, sulphur and ferbam [ferric dimethyldithiocarbamate] the most so; the latter mixture allowed predacious mites to survive on the leaves, but apparently destroyed species in the ground cover. The highest proportion of undamaged fruits resulted from the combination of methoxy-DDT, DDD and captan, whereas Black Leaf 253 with Phygon [dichloronaphthoquinone] early and ferbam late in the season gave the best control of pests.

The main finding in the chemical analyses of sprayed fruit was the increased sugar content that followed treatment including glyodin [2-heptadecyl glyoxalidine acetate] (Crag 341). Such fruits had the best flavour, and those treated with Black Leaf 253 with Phygon or ferbam the worst.

Clower (D. F.) & Matthysse (J. G.). **Phytotoxicity of Insecticides in Mist Concentrate Type Formulations.**—*J. econ. Ent.* **47** no. 5 pp. 735–738, 2 refs. Menasha, Wis., 1954.

The results are given of tests in 1953 on the toxicity of insecticides and acaricides in mist-blower formulations to some 30 species of trees and woody ornamental plants. The insecticides comprised malathion, lindane [almost pure γ BHC], heptachlor, chlordane, p,p′methoxy-DDT (methoxychlor), endrin, isodrin, aldrin, dieldrin and DDT, and of these the first four caused the most injury and the last four the least. The acaricides were DMC [1,1-bis(p-chlorophenyl)ethanol], Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], Ovotran (p-chlorophenyl p-chlorobenzenesulphonate), Chlorobenzilate [ethyl 4,4′-dichlorobenzilate] and compound 923 [2,4-dichlorophenyl benzenesulphonate]; the first was the most and the last three the least phytotoxic. Phytotoxicity varied with plant species, toxicants relatively safe on many species sometimes causing severe injury on a susceptible one.

Matthysse (J. G.), Miller (H. C.) & Thompson (H. E.). **Insecticide Deposits for Control of Elm Bark Beetles.**—*J. econ. Ent.* **47** no. 5 pp. 739–746, 8 refs. Menasha, Wis., 1954.

Control of the Dutch elm disease, caused by *Ceratostomella ulmi*, in the United States is based on prevention of feeding and breeding by the principal vectors, *Scolytus multistriatus* (Marsham) and *Hylastes* (*Hylurgopinus*) *rufipes* Eichh., and the authors give the results of tests of insecticides for this purpose made in New York in 1948–51. The following is based on their summary of the work. Single annual prefoliar treatments of American elms (*Ulmus americana*), followed by chemical analyses and tests with the bark-beetles in the laboratory, indicated that DDT suspensions weathered too rapidly to remain effective during the period of 2–3 months when protection is most needed, whereas heavy applications of DDT in emulsified solutions gave deposits that persisted for long periods. However, protection was incomplete in tall trees after three months, and in general, deposits in tree tops were inadequate for complete protection, even though a large quantity of spray was applied per tree. Tree-top deposits from mists of DDT in kerosene solution were not better than those from emulsified solutions applied by hydraulic sprayer, but the use of a less volatile carrier oil increased them somewhat. Although the laboratory assays indicated incomplete protection, observations on the spread of the disease showed that feeding by *H. rufipes* was so much reduced that the probability of infection was greatly decreased, and a less extensive experiment provided evidence that infection by *S. multistriatus* may be similarly reduced. The advisability of annual DDT treatments is questionable, as foliage injury and increased populations of *Myzocallis ulmifolii* (Monell) and mites resulted when treatment was repeated for three years [*cf. R.A.E.*, A **43** 244]; solutions were more injurious than emulsions. The treatments proved so effective against *Galerucella luteola* (Müller) (*xanthomelaena* (Schr.)) that subsequent sprays were not required.

In laboratory experiments, bark deposits from emulsion sprays of dieldrin, parathion and lindane (almost pure γ BHC) were equal or superior to those from DDT against the bark-beetles after weathering for several weeks. Dieldrin was the most effective and probably the most practical for use, and mist-blower applications showed that it provided effective protection at lower dosages than were necessary for DDT.

Johansen (C. A.), Westlake (W. E.), Butler (L. I.) & Bry (R. E.). **Residual Action and Toxicity of Methoxychlor and Parathion to the Cherry Fruit Fly.**—*J. econ. Ent.* **47** no. 5 pp. 746–749, 1 graph, 4 refs. Menasha, Wis., 1954.

In investigations in the Yakima Valley of Washington in 1952–53, cherry trees were sprayed with p.p′methoxy-DDT (methoxychlor) as a wettable powder or emulsified solution at 1 lb. toxicant per 100 U.S. gals., with parathion in the same forms at 0·25 lb. per 100 U.S. gals. or with a mixture of the two as wettable powders at 0·5 and 0·125 lb., respectively, and persistence was measured by chemical analysis of residues and exposure of adults of *Rhagoletis cingulata* (Lw.) to samples of the leaves. The results showed that residues of methoxy-DDT were usually higher but mortalities lower for emulsified solutions than for wettable-powder sprays, apparently owing to some inherent qualities of the adjuvants in the preparations used. Parathion gave both greater deposits and higher mortalities in wettable-powder than in emulsion sprays, and in a further test, in which 0·25 lb. parathion per 100 U.S. gals. in wettable powder was compared with 0·5 lb. in emulsion, residues and mortalities were approximately equal; variation in effectiveness appeared to be mainly due to differences in deposition. The mixed spray retained its effectiveness for longer than either material alone in some tests and for a shorter period in others.

When wettable-powder and emulsion sprays of methoxy-DDT, emulsion sprays of parathion and emulsion sprays of the two at half the concentrations were applied in a series of dilutions in a spray chamber to the flies, the concentrations giving 50 per cent. mortality in six days were 0·45, 0·007 and 0·34 per cent., respectively, for methoxy-DDT, parathion and the mixture, indicating no great alteration in toxicity due to combining the two insecticides. Although parathion was much more toxic than methoxy-DDT in the laboratory, a disproportionately high rate of application is necessary in the field to obtain residual control.

Lawson (F. R.), Lucas (G. B.) & Hall (N. S.). **Translocation of radioactive Phosphorus injected by the Green Peach Aphid into Tobacco Plants.**—*J. econ. Ent.* **47** no. 5 pp. 749–752, 1 fig., 9 refs. Menasha, Wis., 1954.

The following is based on the authors' introduction and summary. *Myzus persicae* (Sulz.) has recently become an important pest of tobacco in the United States, not only excreting honeydew on which sooty moulds develop but also causing yellowing and stunting of the leaves on which it feeds. In experiments carried out in North Carolina in 1951, radioactive phosphorus ($P^{32}$) was used to determine whether the substances injected by this Aphid into living plants are translocated. Aphids that fed on tobacco plants growing in soil treated with an aqueous solution of radioactive phosphoric acid became radioactive, and the tracer was found in their honeydew and excreta, in the cast skins and in young born of radioactive individuals, though this may have been partly due to contamination with honeydew. It was also found in leaves on which the Aphids had fed, into which it was probably injected with the salivary secretions. The $P^{32}$ introduced into the leaf by the Aphids was translocated to other parts of the plant, and it is therefore concluded that part of the injury to tobacco caused by *M. persicae* may be due to translocation of injected salivary secretions.

Young (M. T.) & Gaines (R. C.). **Control of Insects and Spider Mites on Cotton in 1953.**—*J. econ. Ent.* **47** no. 5 pp. 753–756. Menasha, Wis., 1954.

Tests for the control of cotton pests in Louisiana were continued in 1953, when *Anthonomus grandis* Boh. was the most important of those present, though it was considerably reduced by the hot dry summer, *Psallus seriatus* (Reut.) occurred in large numbers in late June and early July, *Tetranychus bimaculatus* Harvey, *T. desertorum* Banks and *Aphis gossypii* Glov. were not injurious, and damage by *Heliothis armigera* (Hb.) was light. The cotton was sown in the second half of April, and treatments were applied 7–8 times between the end of June and 19th August, except in the last test, dusts at about 10 lb. per acre with rotary hand dusters in early morning or late afternoon and sprays, which were used in the third and fourth tests only, with one nozzle per row when the plants were dry.

In the first test, dusts of 20 per cent. toxaphene and dust mixtures of 3 per cent. γ BHC and 5 per cent. DDT with Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], Metacide [methyl-parathion and parathion], parathion, special oil or sulphur, and of 6 per cent. γ BHC with 10 per cent. DDT gave satisfactory control of *Anthonomus*, whereas 2 per cent. Metacide alone did not; all controlled *P. seriatus* and caused small increases in yield. Mites increased in the plots receiving DDT and γ BHC alone or with the oil. In the second, 2·5 per cent. methyl-parathion with 5 per cent. DDT gave good control of *Anthonomus* and the greatest increase in yield, proving superior to 4 per cent. malathion, 20 per cent. Strobane [a wettable powder containing a chlorinated mixture of α-pinene isomers with a chlorine content of approximately 66 per cent.] or mixtures of 5 per cent. DDT and 40 per cent. sulphur with 2·5 per cent. aldrin, 3 per cent. γ BHC or 1·5 per cent. dieldrin and equal in control to a similar mixture containing 2·5 per cent. heptachlor; all but the first of these caused significant increases in yield, and all controlled a heavy infestation of *P. seriatus* on 1st July. In the third, dust mixtures of 3 per cent. γ BHC, 5 per cent. DDT and 40 per cent. sulphur and of 20 per cent. toxaphene and 40 per cent. sulphur and sprays of 0·6 lb. γ BHC with 1 lb. DDT, or 5 lb. malathion, 4 lb. Metacide or 2 lb. methyl-parathion per U.S. gal. all controlled *Anthonomus* and *P. seriatus*, and all but the last resulted in significant increases in yield, the greatest being in the plots receiving BHC and DDT in dust or spray.

In the fourth test, alternate applications of a dust mixture of 3 per cent. γ BHC with 5 per cent. DDT and 40 per cent. sulphur and of calcium arsenate, and applications of 20 per cent. toxaphene with 40 per cent. sulphur and of sprays containing 2 lb. DDT with 2 lb. aldrin, 1·5 lb. dieldrin or 1 lb. heptachlor per U.S. gal., 0·6 lb. dieldrin with 0·8 lb. endrin or 1·6 lb. endrin alone all reduced damage by *Heliothis* and controlled *P. seriatus*. Aphids increased on the dusted plots and that sprayed with DDT and heptachlor; endrin gave slightly better control of *Anthonomus* and greater increases in yield than other treatments, but all but DDT with heptachlor and toxaphene with sulphur caused significant increases. In the fifth, a dust of 2·5 per cent. aldrin and 5 per cent. DDT and one of 3 per cent. γ BHC, 5 per cent. DDT and 40 per cent. sulphur alternated with calcium arsenate gave satisfactory control of *Anthonomus* and *P. seriatus* and reduced injury by *Heliothis*, the alternated dusts proving slightly superior and giving a greater increase in yield. In the last test, dusts of 5 per cent. DDT with 3 per cent. γ BHC and 40 per cent. sulphur and with 2·5 or 5 per cent. chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate], applied four times between 31st July and 19th August, all reduced damage by *Heliothis*. The BHC dust gave the best control of

*Anthonomus*, but DDT with 2·5 per cent. chlorthion resulted in the greatest increase in yield; both the chlorthion mixtures had poor dusting qualities.

Messenger (P. S.) & Flitters (N. E.). **Bioclimatic Studies of three Species of Fruit Flies in Hawaii.**—*J. econ. Ent.* **47** no. 5 pp. 756–765, 5 figs., 3 refs. Menasha, Wis., 1954.

The following is substantially the authors' summary of this detailed progress report of bioclimatic studies of *Dacus dorsalis* Hend. and other fruit-flies made in Hawaii in 1951–53 [*cf. R.A.E.*, A **42** 8]. Temperatures and relative humidities of 18 different climatic areas in the continental United States were simulated in bioclimatic cabinets in Honolulu, and the responses of *D. dorsalis*, *D. cucurbitae* Coq. and *Ceratitis capitata* (Wied.) were noted. The climates studied involved entire annual cycles and included those of nine localities in California, three in Florida, two in Texas and one each in Arizona, Louisiana, Indiana and South Carolina.

When adequate food was provided, the duration of development of the immature stages and the length of the life-cycles of all three species were almost completely governed by temperature. The summer conditions of many mainland climates permitted growth rates approaching those found in Honolulu, but the summer temperatures of the localities in the semi-arid areas of the south-west, such as those of Tempe, Arizona and of Fresno and El Centro, California, were too hot for continuous reproduction. The winter conditions in most of the climates studied, except those of Florida, Louisiana and Texas, were too cold and caused complete cessation of reproduction and development and high mortalities.

From the continuous reproduction and development and the steady increase of successive generations, it appears that optimum climatic conditions for these fruit-flies exist in central and southern Florida, southern Louisiana and southern Texas, and marginal conditions of temperature probably in narrow sections just north of these. Parts of southern California appear to have optimum or marginal winters, but have extreme summer temperatures that interfere with reproduction.

Hamilton (D. W.), Summerland (S. A.) & Fahey (J. E.). **Codling Moth Control Experiments, 1950–1953.**—*J. econ. Ent.* **47** no. 5 pp. 768–775, 3 refs. Menasha, Wis., 1954.

The following is based on the authors' summary. Laboratory and field experiments with various insecticides for the control of *Cydia* (*Carpocapsa*) *pomonella* (L.) on apple were carried out at Vincennes, Indiana, in 1950–53. Laboratory tests of DDT deposits against larvae of three strains with different histories of exposure to DDT did not indicate that any of the strains had developed resistance, and it is concluded that weather favourable for activity of *C. pomonella*, inadequate coverage with the concentrated sprays now commonly used and possible reductions in DDT deposits owing to other spray ingredients may have contributed to an increase in injury in 1952 and 1953 over that in 1950 and 1951.

DDT, parathion, EPN [ethyl p-nitrophenyl thionobenzenephosphonate], Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate], Metacide [methyl-parathion and parathion], CS-708 [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane], p,p′methoxy-DDT (methoxychlor) and ryania were the most promising materials for control in tests of sprays. Parathion and Metacide were especially effective in killing eggs, young larvae in the fruits, and

adults, but weathered too rapidly to be complete substitutes for DDT against the larvae. Control with DDT was high when the deposit on the fruits was maintained at 7·5 mmg. per sq. cm. In orchards, the best control was obtained with a combination of DDT and parathion; the addition of DMC [1,1-bis(p-chlorophenyl)ethanol] or Compound 876 [bis(p-chlorophenyl)-ethynyl-carbinol, here referred to as 1,1-bis(p-chlorophenyl)-2-propyn-1-ol] caused very little increase in the larvicidal efficiency of DDT.

Walton (R. R.). **Seasonal Fluctuations of the Green Peach and Turnip Aphids on commercial Greens Crops in Oklahoma.**—*J. econ. Ent.* **47** no. 5 pp. 775–780, 2 graphs, 9 refs. Menasha, Wis., 1954.

The following is based on the author's summary. The principal pests of spinach and cruciferous vegetables in Oklahoma are *Myzus persicae* (Sulz.) and *Rhopalosiphum pseudobrassicae* (Davis), respectively. Investigations in 1946–51 showed that temperature was the critical factor in Aphid development. *M. persicae* appeared to be active in and round the spinach-growing areas during the entire year, being present on spinach from October to May and occurring in light infestations during the summer on a large number of cultivated and wild plants. *R. pseudobrassicae* usually occurred on cruciferous crops from August to December and during the spring, and outbreaks may occur in either season. It was collected on crucifers, lettuce and bush beans. Temperatures below normal in early autumn, mid-autumn and spring and above normal in late autumn and winter appeared to favour its development, and temperatures below freezing point did not seem to cause an immediate reduction in population unless they approached 0°F.

Walton (R. R.) & Howell (D. E.). **Control of Aphids on commercial Greens Crops by Insecticides.**—*J. econ. Ent.* **47** no. 5 pp. 780–785, 11 refs. Menasha, Wis., 1954.

The results are given of 25 field and laboratory experiments in which 14 insecticides were tested for the control of Aphids on vegetable crops in eastern Oklahoma [*cf.* preceding abstract], the species concerned being *Myzus persicae* (Sulz.) on spinach in 1946–51 and *Rhopalosiphum pseudobrassicae* (Davis) on crucifers in 1948–50.

Highly volatile compounds showed the most promise. Of those used in both sprays and dusts, parathion, tested at 0·15–0·4 lb. per acre, and a mixture of parathion and methyl-parathion at 0·12–0·5 lb. were the most effective, followed by lindane [almost pure γ BHC] at 0·2–0·56 lb. TEPP [tetraethyl pyrophosphate] at 0·23 lb. in a dust was very effective when applied under dry and warm conditions, but much less so when used on wet foliage or at temperatures below 60°F., and a nicotine-sulphate dust was similarly affected by temperature and was not included in later tests. BHC dusts (1–2 per cent. γ isomer) were effective against *M. persicae* at 0·5–1 lb. toxicant per acre in 1947, but had an adverse effect on plant flavour. Dusts were more effective than sprays containing the same toxicants, but their effectiveness declined with increase in plant size and with the lateral distance of the plant from the duster outlet. The effectiveness of TEPP dusts and sprays was greatly reduced when the velocity of the wind in which they were applied increased from less than 10 m.p.h. to 25–30 m.p.h.

Relatively non-volatile materials, including DDT, methoxy-DDT (methoxychlor), chlordane, toxaphene, rotenone, sabadilla, and mixtures of pyrethrins with synergists and rotenone were generally ineffective, since

Aphids in convolutions and cavities on the foliage surface appeared to be largely protected from them, whereas the volatile toxicants seemed to penetrate such situations and effect control.

Huffaker (C. B.), Holloway (J. K.), Doutt (R. L.) & Finney (G. L.). **Introduction of Egg Parasites of the Beet Leafhopper.**—*J. econ. Ent.* **47** no. 5 pp. 785–789, 9 refs. Menasha, Wis., 1954.

Curly-top disease, transmitted by *Circulifer tenellus* (Baker), formerly caused severe injury to sugar beet in the western United States but now more seriously affects tomatos, beans, cucurbits, spinach and flax. Following a survey of the distribution of the Jassid in Mediterranean countries [*cf. R.A.E.*, A **42** 77], attempts were made to establish introduced egg-parasites against it in California, where it causes serious damage to early tomatos. One shipment of plant material containing parasitised *Circulifer* eggs was received from Tripolitania (Libya) in 1951, 14 from Spain in 1952 and 20 from Spain and French Morocco in 1953. Of the primary parasites that emerged, *Aphelinoidea anatolica* Nowicki from Tripolitania, an unidentified species of *Polynema* referred to as "A" from Morocco and two unidentified species of *Lymaenon* referred to as "A" and "B" and one of *Aphelinoidea* referred to as "A" from Spain showed promise against *C. tenellus*. Their life-cycles lasted only 2–3 weeks at 80°F. in the laboratory, but they varied considerably in ability to complete development and emerge from dry to drying plant tissue; comparative tests revealed that *A. plutella* Gir., a native parasite of *C. tenellus* in the semi-arid areas of California, could overwinter within the dead and dry tissues of such food-plants of the Jassid as Russian thistle (*Salsola kali* var. *tenuifolia*) and aestivate in those of winter annuals such as filarea (*Erodium cicutarium*). *A. anatolica* was released at one site in 1951, after which the stock was lost, *Lymaenon* "B" at another in 1953, and the other three at various sites in a great variety of ecological conditions, which are discussed, also in 1953. *Lymaenon* "A" was recovered soon after release, but not later in the year, in two localities in which releases had been made before the drying of the winter annual vegetation, and *Polynema* "A", which was released from midsummer onwards, from Russian thistle during the latter half of the season.

Ebeling (W.) & Pence (R. J.). **Susceptibility to Acaricides of Two-spotted Spider Mites in the Egg, Larval and Adult Stages.**—*J. econ. Ent.* **47** no. 5 pp. 789–795, 3 graphs, 3 refs. Menasha, Wis., 1954.

The following is based on the authors' summary. The median lethal dosages were determined in the laboratory for 16 acaricides tested as wettable powders, emulsifiable concentrates or both against eggs, larvae and adults of *Tetranychus bimaculatus* Harvey on bean leaves. The comparative susceptibility of the developmental stages varied with different groups of acaricides, the median lethal dosages of Aramite (2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite) and the organic phosphates, parathion, malathion, EPN (ethyl p-nitrophenyl thionobenzenephosphonate), Diazinon (O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate) and demeton (diethyl 2-(ethylmercapto)ethyl thiophosphate), being higher for the larvae than for the adults, those of Chlorobenzilate (ethyl 4,4′-dichlorobenzilate), DMC [1,1-bis(p-chlorophenyl)-ethanol], R-242 (p-chlorophenyl phenyl sulphone and related materials) and Compound 876 (bis(p-chlorophenyl)-ethynyl-carbinol) being similar for the two

stages, and those of Neotran (di(p-chlorophenoxy)methane), Ovotran (p-chlorophenyl p-chlorobenzenesulphonate), Compound 923 (2,4-dichlorophenyl benzenesulphonate), Karathane (dinitrocaprylphenylcrotonate), dinex (dicyclohexylamine) and dinoseb (triethanolamine) being lower for the larvae than for the adults. The median lethal dosages of Neotran, Ovotran and Compound 923 were lower for the eggs than for the adults, whereas the eggs were by far the most resistant stage against all other compounds, the median lethal dosage for the eggs by topical treatment being 37·7 times as great, on the average, as that for adults exposed to residues. The ratio was particularly high for Aramite and the organic phosphates, partly owing to the extremely low concentrations required to kill the adults.

The mortality of adults on the lower surfaces of bean leaves treated only on the upper surfaces was greatly affected by the age and condition of the leaf. The mortality at a given concentration of toxicant was greater on the more mature leaves and on those that were severed from the plant. When non-systemic acaricides were applied to the upper surfaces of bean leaves and adults were confined to the lower surfaces, the median lethal dosages were on an average 18·8 times as high as when the mites were on the treated surfaces. The difference was least with parathion and DMC.

Emulsifiable concentrates were nearly always initially more effective than wettable powders against all stages of *T. bimaculatus*, but previous experiments on adults indicated that wettable powders retained their effectiveness for longer periods.

Batzer (H. O.) & Benjamin (D. M.). **Cold Temperature Tolerance of the European Pine Shoot Moth in Lower Michigan.**—*J. econ. Ent.* **47** no. 5 pp. 801–803, 3 refs. Menasha, Wis., 1954.

An infestation of *Rhyacionia buoliana* (Schiff.) that was confined to some three acres of a plantation of red pine [*Pinus resinosa*] near Cadillac, Michigan, in the summer of 1951 had spread over the remaining 50 acres by 1952, and the moth was present in most plantations from Cadillac westwards to Lake Michigan in 1953. As low winter temperatures had been believed to limit the northward distribution of the moth [*cf. R.A.E.*, A **25** 90] and winter temperatures at Cadillac had fallen below the assumed critical lethal level of −18°F. 11 times in the previous 12 years, reaching −43°F. in 1950–51 and −23°F. in 1951–52, the cold-hardiness of overwintering larvae from this area was compared with that of examples from Lansing, further south in the same State, where minimum temperatures below −18°F. occur, on an average, only once in ten years, and *R. buoliana* is always injurious. No significant difference was found in the laboratory between the two lots of larvae; mortality was almost complete after exposure for 48 hours to −13°F. and complete after eight hours at −22°F., and it is concluded that the threshold of survival probably lies between these temperatures.

Fife (L. C.) & Walker (R. L.). **Comparative Effectiveness of various Phosphorus and Chlorinated Hydrocarbon Insecticides for Control of Cotton Pests.**—*J. econ. Ent.* **47** no. 5 pp. 803–807, 2 refs. Menasha, Wis., 1954.

The following is substantially the authors' summary. Several phosphorus compounds and chlorinated-hydrocarbon insecticides were tested against *Anthonomus grandis* Boh., *Alabama argillacea* (Hb.), *Aphis gossypii* Glov., *Tetranychus desertorum* Banks and *T. bimaculatus* Harvey on cotton at

Florence, South Carolina, in 1953, methyl-parathion, chlorthion (O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate), EPN [ethyl p-nitrophenyl thionobenzenephosphonate], endrin, isodrin and Strobane (a chlorinated mixture of α-pinene isomers) being compared with the recommended insecticides, BHC, heptachlor, toxaphene, aldrin and dieldrin.

Methyl-parathion applied at 0·25 lb. or more per acre in a dust or spray and chlorthion at 0·25 lb. in a dust gave satisfactory control of the overwintered adults of *Anthonomus* but were less effective against the summer generations than the standard insecticides; they were also effective against *Aphis gossypii* and the mites and showed a long residual toxicity against *Alabama*. At 0·35–0·5 lb. per acre, chlorthion in a dust and methyl-parathion in dusts and sprays usually gave good seasonal control of *Anthonomus*. In two of three experiments, yields were lower in plots treated with chlorthion, regardless of dosage, than in those treated with chlorinated hydrocarbons.

The results with EPN were somewhat erratic; at 0·5 lb. per acre in a dust or spray, it was effective against the overwintered *Anthonomus* adults, but inconsistent against the summer generations. It had a long residual toxicity against *Alabama*. Strobane at 2 lb. per acre in dust or spray gave effective seasonal control of *Anthonomus*, which was increased in two experiments by the addition of DDT. Endrin gave good seasonal control of *Anthonomus* at 0·2 lb. per acre and was outstanding at 0·3 lb.; isodrin compared favourably with endrin at the same dosage.

Fronk (W. D.) & Peterson (L. E.). **Some Effects of treating Muskmelons with Insecticides.**—*J. econ. Ent.* **47** no. 5 pp. 807–811, 9 refs. Menasha, Wis., 1954.

Near Muscatine, Iowa, adults of *Acalymma vittata* (F.) destroy or seriously injure seedling muskmelons as they appear above ground and also infect the plants with bacterial wilt; the larvae injure the rind of fruits resting on the soil. In 1949–52, insecticides were tested for their effects on injury by *A. vittata* and on the condition of the plants, and the results are given in detail. Differences in yield were not significant, but plots treated with DDT, methoxy-DDT (methoxychlor), DDD (TDE), Q-137 [ethyl-DDD (2,2-bis(p-ethylphenyl)-1,1-dichloroethane)], aldrin, lindane [almost pure γ BHC] or heptachlor usually produced higher yields than others. In 1949, when dusts were applied at weekly intervals from 5th May to 15th June, 2·5 per cent. dieldrin or aldrin and 1 per cent. γ BHC were the most effective in reducing larval injury to the fruits, and 5 per cent. chlordane, 3 per cent. DDT and 0·75 per cent. rotenone resulted in significant reductions; all treatments reduced wilt infection, but BHC, 5 per cent. toxaphene and 3 per cent. fluoro-DDT (DFDT) proved too phytotoxic for normal use. In 1950, when insecticides were applied weekly from 18th May to 22nd June in sprays at concentrations of 1:400 (except for tetraethyl dithiono-pyrophosphate, which was used at 1:800) or in dusts, sprays of heptachlor, CS-708 [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane], dieldrin, aldrin, Q-137 or DDD and dusts of 5 per cent. heptachlor or 2·5 per cent. aldrin or dieldrin caused significant increases in plant growth but did not affect yield or injury significantly.

In 1951, the effect was tested of varying the number of applications and the intervals between them; plots were treated at intervals of 3, 5 or 7 days for periods of 3, 4·5 or 6 weeks from 3rd June with sprays containing DDT, methoxy-DDT and a mixture of DDT and parathion at 1:400 or with lindane and heptachlor at 1:800. DDT, heptachlor and the mixture caused

significant reductions in the percentage of fruits injured, and the last in the number of plants killed by wilt. In all cases, the longest interval between treatments resulted in the highest yields. Plants treated for six weeks yielded no more than those treated for three weeks, but the longer period of protection tended to decrease the percentage of fruits injured and of plants killed by wilt. In 1952, when lindane was tested at concentrations of 1:400, 1:800 and 1:1,200 and heptachlor, DDT and methoxy-DDT at 1:200. 1:400 and 1:800, there were no significant differences in stand, yield, number of fruits, number of wilted plants or plant growth, but heptachlor (1:800) resulted in the greatest weight and number of fruits and in the greatest plant growth, and DDT in the least number of wilted plants. Plant growth was least and yield lowest for DDT at 1:200.

Burrage (R. H.) & Gyrisco (G. G.). **Estimates of Populations and Sampling Variance of European Chafer Larvae from Samples taken during the first, second and third Instar.**—*J. econ. Ent.* **47** no. 5 pp. 811–817. Menasha, Wis., 1954.

Larvae of *Amphimallon majalis* (Razoum.) are serious pests of permanent pasture in four counties in New York State, feeding extensively on the fine roots and root hairs of grasses and clovers. In investigations on their ecology and control it is often necessary to estimate the population density, and tests were therefore carried out in 1951–52 on the reliability of sampling populations in the first, second and third instars.

The eggs of *A. majalis* are laid in late June or early July, and larvae in the three instars are present in July, in August and from late August to May, respectively, the prepupae and pupae in May and June, and the adults from late June onwards. The investigations showed that soil from which counts are to be obtained must be sifted through appropriate sieves if larvae of either the first or second instar are to be separated from it, whereas those of the third instar can be separated by hand. Since the latter procedure is the more rapid, population estimates are most easily obtained during the third instar. There is some mortality of overwintering larvae, and estimates obtained in spring may be considerably lower than those of the previous autumn. There was also some evidence that distribution becomes more uniform as the larvae develop and migrate through the soil, so that a sampling procedure that is satisfactory for one instar may not be applicable to the same population during others.

Walker jr. (J. K.), Mistric jr. (W. J.) & Martin (D. F.). **Evaluation of Interval and Dosage in Bollworm Control.**—*J. econ. Ent.* **47** no. 5 pp. 824–826, 2 refs. Menasha, Wis., 1954.

The following is based on the authors' summary. Small-plot tests of sprays for the control of *Heliothis armigera* (Hb.) on cotton were carried out near College Station, Texas, from 23rd July to 8th September 1953 to determine the effects of different intervals between applications and of increases in dosage when the intervals were greater than five days. DDT applied every five days at the rate of 1·5 lb. per acre resulted in significantly better control and significantly higher yields than the same amount applied at intervals of seven or ten days or than 0·75 lb. per acre applied every five or seven days. All treatments gave significantly better control and higher yields than none. Mixtures of toxaphene and DDT (2:1) and of dieldrin and DDT (1:2), applied every four days, gave significantly better control

than the same materials used every eight days or than a mixture of aldrin and DDT (1:2) used every four days; the last was as effective as any of the mixtures applied every eight days.

Martin (D. F.) & Mistric jr. (W. J.). **Endrin Spray for Bollworm Control.** —*J. econ. Ent.* **47** no. 5 pp. 827–829, 4 refs. Menasha, Wis., 1954.

The following is based on the authors' summary. Two small-plot field tests were carried out near College Station, Texas, in 1953, on the effectiveness of sprays of endrin, alone and with DDT, for the control of an injurious infestation of *Heliothis armigera* (Hb.) on cotton. In one, endrin at 0·33 lb. per acre and endrin with DDT (1:1) at 0·48 lb., mixtures of toxaphene and DDT (1:2) at 2·91 lb., γ BHC and DDT (3:5) at 0·87 lb. and EPN [ethyl p-nitrophenyl thionobenzenephosphonate] and DDT (1:2) at 0·96 lb. active ingredient per acre, applied six times between 8th July and 18th August, were about equally effective and caused significant increases in yield of seed cotton, with no significant differences between them. Similar results were obtained in the other, in which endrin at 0·25, 0·34 and 0·53 lb. and mixtures of endrin and DDT (1:2) at 0·75 lb. and toxaphene and DDT (1:2) at 2·92 lb. active ingredients per acre were applied nine times between 23rd July and 17th September.

Medler (J. T.). **Three-year Test for Meadow Spittlebug Control in Alfalfa.** —*J. econ. Ent.* **47** no. 5 pp. 842–847, 8 refs. Menasha, Wis., 1954.

Experiments were carried out in Wisconsin in 1950–52 to test new insecticides for the control of *Philaenus leucophthalmus* (L.) on lucerne. Emulsion sprays prepared in the laboratory were applied with low-volume apparatus, and the results were estimated by counting spittle masses on stem samples and by sweeping; analysis of data obtained in the two ways showed a highly significant correlation coefficient.

Chlorinated hydrocarbons proved the most effective, phosphorus compounds (including systemic insecticides), nitroparaffins and insecticides of plant origin showing no promise. Statistical analysis of the data relating to the chlorinated hydrocarbons, using each year's work as a replicate of the experiment, showed highly significant differences between treatments. Dieldrin, lindane [almost pure γ BHC], toxaphene and p,p′methoxy-DDT (methoxychlor) were the best materials, in order of efficiency, 0·25 lb. dieldrin or lindane or 1 lb. toxaphene per acre resulting in a mean of 0·3 spittle masses per 100 stems, 2 lb. methoxy-DDT and 0·5 lb. toxaphene in 1·3, and 0·125 lb. dieldrin in 1·6.

Biological observations showed that the date for the hatching of the nymphs in Wisconsin was about 1st May, but that it may be delayed by periods of prolonged cool weather. Some of the eggs were found to be parasitised by an undescribed species of *Centrodora*.

Peterson (A. G.) & Noetzel (D. M.). **Seed Treatments compared with other Methods for controlling the Onion Maggot.**—*J. econ. Ent.* **47** no. 5 pp. 852–859, 16 refs. Menasha, Wis., 1954.

The following is based on the authors' introduction and summary. *Hylemyia antiqua* (Mg.) has caused unusually severe injury to onions in Minnesota in recent years, and seed treatments for its control were tested in 1952–53. Counts of injured plants early in the season and at harvest and observation of plant stands and yields of marketable onions showed

that 4 oz. 25 per cent. heptachlor, 2·5 oz. 40 per cent. aldrin or 2 oz. 50 per cent. dieldrin, mixed with 4 oz. 50 per cent. thiram [tetramethyl thiuram disulphide] as a fungicide and pelleted on 1 lb. seed by means of 3–3·5 oz. 4 per cent. methyl cellulose [*cf. R.A.E.*, A **43** 214], gave effective control from sowing until harvest, and that dry mixtures of 2 oz. 50 per cent. dieldrin or 75 per cent. aldrin with 2 oz. 50 per cent. thiram per lb. seed, applied without an adhesive, gave good control, though the limited amount of thiram that could be applied in this way may not prove adequate against smut. Heptachlor and aldrin in granules [*cf.* **41** 370], broadcast at 3–4·5 lb. actual insecticide per acre and worked into the top inch or two of soil, gave results similar to those with pelleted seed, but applications of insecticides in sprays after the plants had appeared were much less effective.

Gyrisco (G. G.) & Burrage (R. H.). **Effects of Soil Treatments with Insecticides on Plant Growth and Fruit Quality of Strawberries.**—*J. econ. Ent.* **47** no. 5 pp. 859–863. Menasha, Wis., 1954.

White grubs [*Lachnosterna*] are important pests of strawberry in New York and sometimes completely destroy new beds by feeding on the roots during the second year of their three-year life-cycle. Laboratory and small-plot field tests having shown that several insecticides gave good control, investigations were carried out on the effect of soil treatments on plant growth and on the flavour and odour of the fruits.

In 1949, parathion and chlordane at 4–12 lb., aldrin, dieldrin and γ BHC at 1–4 lb. and lead arsenate at 250 lb. per acre were applied to soil in dusts and raked in well before strawberry plants were set in it. Examination of the plants four months later and sampling of the fresh or canned fruit, or jam made from it, in the following year revealed no adverse effects, but, with the exception of chlordane, all organic compounds affected the flavour of the fruit produced in 1951. In a further test, aldrin, dieldrin, chlordane and parathion were applied at 1–8 lb. per acre, lindane [almost pure γ BHC] at 0·5–2 lb. and lead arsenate at 250 lb. in dusts on 27th April 1950, and strawberries were planted on 30th April. The dusts were raked into the soil in half the tests and left on the surface in the other half. Examination of the plants on 7th August 1950 revealed no adverse effects due to treatment, whether or not the dusts were raked in, but aldrin, dieldrin and lindane affected the flavour of the fresh or canned fruit produced in 1951. It was obvious that processing the fruit accentuated any taint that was present.

Kulash (W. M.). **Growers Trials for Control of Wireworms attacking Corn.**—*J. econ. Ent.* **47** no. 5 pp. 863–866, 1 ref. Menasha, Wis., 1954.

Field tests with organic insecticides for the control of wireworms attacking maize in North Carolina [*cf. R.A.E.*, A **43** 51] were carried out in 1952. *Melanotus communis* (Gylh.) was the principal species concerned, but *Conoderus lividus* (Deg.) and *Glyphonyx recticollis* (Say) were also present. In the first test, heptachlor was applied as a dressing to the moistened seed at 4 oz. 25 per cent. wettable powder per bushel, to drill rows in the soil at 100 lb. 5 per cent. dust per acre, disked in to a depth of about 4 ins., a fortnight before sowing, or to both. The three treatments increased the plant stand by 20–30 per cent. and reduced the percentage damaged by wireworms from 10·8, 9·4 and 10·3 to 5·2, 1·1 and 1·9, respectively, indicating that the combined treatment was little better than soil treatment alone. In

the second, in which the seed was coated with 40 per cent. aldrin, 50 per cent. dieldrin or 25 per cent. heptachlor at 5·7, 5·5 and 8 oz. per bushel, respectively, and with 75 per cent. lindane [almost pure γ BHC] at 1·5 oz., with or without 1 oz. fungicide per bushel, the first three treatments increased the average number of plants per row sample from 193 to 254, 246 and 247 and decreased the percentage damaged by wireworms from 32·6 to 8·6, 11 and 14·2, respectively, whereas the last two reduced the percentage damaged from 58·2 to 36·6 and 55·3, respectively, and tended to reduce the plant stand.

In the third test, in which emulsion concentrates were applied to strips 4 ins. wide along the row as the seed was sown, on 24th April, aldrin, applied at 4 and 2 oz. actual toxicant per 12,400 ft. of row (1 acre) increased the number of plants present per row sample on 30th May from 193 to 210 and 315 and reduced the percentage damaged from 32·6 to 7·1 and 13·3, respectively. Heptachlor and dieldrin at 8 oz. increased the number of plants to 208 and 235 and decreased the percentage damage to 11·1 and 13·6, whereas 1 oz. aldrin gave little control and 10 oz. lindane none, and the last reduced the number of plants.

Anthon (E. W.). **Peach Silver Mite Control.**—*J. econ. Ent.* **47** no. 5 pp. 866–868, 2 refs. Menasha, Wis., 1954.

*Vasates cornutus* (Banks) has increased on peach in north-central Washington of recent years [*cf. R.A.E.*, A **38** 35], and dormant or delayed-dormant sprays of lime-sulphur, alone or with oil, in 1952 and 1953, failed to give control for the season. In tests in 1952, single applications on 23rd July of 0·25 and 0·5 U.S. pint Systox emulsion containing 42·4 per cent. active ingredient [diethyl 2-(ethylmercapto)ethyl thiophosphate], 1 U.S. pint Chlorobenzilate emulsion [25 per cent. ethyl 4,4′-dichlorobenzilate], 3 lb. Sulphenone (40 per cent. wettable p-chlorophenyl phenyl sulphone) and 1·5 U.S. pints 15 per cent. Aramite emulsion [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] per 100 U.S. gals. gave excellent control for a month, and 1 U.S. pint DMC [1,1-bis(p-chlorophenyl)ethanol] gave good initial kill but failed to maintain control.

In 1953, when sprays were applied on 3rd–4th August, 3 lb. wettable sulphur per 100 U.S. gals. caused reductions in population that were highly significant, and 0·5 U.S. pint Systox, 0·5–1 U.S. pint Chlorobenzilate and 1 lb. Compound 876 (50 per cent. bis(p-chlorophenyl)ethynyl carbinol) per 100 U.S. gals. reductions that were significant, whereas 2 U.S. pints 57 per cent. malathion emulsion, 3 lb. wettable malathion and 1 U.S. pint TEPP [tetraethyl pyrophosphate] led to significant increases in numbers.

Merkl (M. E.) & Dunnam (E. W.). **Tests against Cotton Pests with some new Dust and Spray Formulations.**—*J. econ. Ent.* **47** no. 5 pp. 869–871, 1 ref. Menasha, Wis., 1954.

Tests of new preparations for the control of cotton pests in Mississippi in 1952–53 included some with dusts prepared with a fully dispersible and non-wettable form of chemically treated calcium carbonate as diluent [*cf. R.A.E.*, A **42** 282]. In 1952, dust mixtures that had been stored for 6–8 months retained their effectiveness, and in 1953, when dusts were applied on 17th and 23rd June and 3–5 times between 16th July and 15th August, mixtures of 3 per cent. γ BHC and 5 per cent. DDT with 23 or 60 per cent. calcium carbonate, of 20 per cent. toxaphene with 50 per cent. calcium

carbonate and of 1·5 per cent. dieldrin with 90 per cent. calcium carbonate, applied at about 10·8, 14·9 and 11·1 lb. per acre, respectively, gave good control of the boll weevil [*Anthonomus grandis* Boh.].

A stabilised 2 per cent. endrin dust, applied by aeroplane at 95 lb. per acre in 1953, gave little insect control, apparently owing to poor plant coverage, but in small-plot tests in which it was applied at 5, 10, 20 and 30 lb. per acre with a rotary hand duster, it gave fair control of the weevil, the bollworm [*Heliothis armigera* (Hb.)] and the leafworm [*Alabama argillacea* (Hb.)] at the higher rates. The dust was somewhat repellent to the adult insects, apparently owing to the liberation of ammonia and other gases from the ammonium carbonate and urea used as stabilisers.

In field tests with sprays, two new phosphorus compounds, OS-1836 (diethyl 2-chlorovinyl phosphate) and OS-2046 [dimethyl 1-carbomethoxy-1-propen-2-yl phosphate] (here referred to as 2-carbomethoxyisopropenyl dimethyl phosphate), applied at 0·125, 0·25 and 0·5 lb. per acre, showed considerable promise, but killed beneficial insects at the higher rates. At 0·5 lb. per acre in field-cage tests, they caused 71 and 97 per cent. kill of *Anthonomus*, 80 and 78 per cent. kill of *Alabama* and 60 and 90 per cent. kill of Coccinellids. Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], chlorthion [O,O-dimethyl O-(3-chloro-4-nitrophenyl) thiophosphate] and demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate], applied on 12th August in 3 U.S. gals. spray at 0·5, 0·25 and 0·25 lb. per acre, respectively, gave 98–99 per cent. mortality of *Tetranychus desertorum* Banks in five days and maintained control at this level for another fortnight, whereas 0·25 lb. methyl-parathion or parathion and 0·2 lb. Metacide [methyl-parathion and parathion] were somewhat and 0·25 lb. malathion much less effective.

Smith (E. H.). **Factors influencing the Susceptibility of the Plum Curculio to Lead Arsenate.**—*J. econ. Ent.* **47** no. 5 pp. 871–879, 3 figs., 2 refs. Menasha, Wis., 1954.

Since lead arsenate gives variable control of the adults of *Conotrachelus nenuphar* (Hbst.), the susceptibility of overwintered and newly emerged adults from New York, where the weevil has one generation a year, and of first-generation adults from further south, where it has two, was investigated in the laboratory by exposing the insects to spray deposits on apples. The following is based on the author's summary of the results.

The responses of the various age groups to the deposits showed that susceptibility was highest among the overwintered adults, some of which died without feeding, apparently owing to dehydration resulting from the repellent action of the residue; among the overwintered weevils, it was highest early in the season, decreased thereafter for several weeks and rose again late in the season. The early susceptibility is believed to be associated with low vigour immediately after emergence from hibernation, and the late susceptibility with senility. Summer adults from New York were more resistant than those from further south and caused more feeding injury. There appeared to be no general relationship applying to all classes of adults between rate and extent of feeding and subsequent mortality.

The effectiveness of lead arsenate at three dosage levels was greatest when the insects had access to surface moisture, apparently owing to the ingestion of toxicant with it, but the number of insects feeding and the extent of feeding and oviposition were greater on dry residues. These factors are considered to account for seasonal variations in the effectiveness of lead arsenate under field conditions.

Stahl (C. F.). **Trapping Hornworm Moths.**—*J. econ. Ent.* **47** no. 5 pp. 879–882, 4 figs., 3 refs. Menasha, Wis., 1954.

The following is substantially the author's summary. Studies were made of the value of traps as possible aids in the control of hornworms on tobacco, based on data obtained at four localities in Tennessee, Florida, North Carolina and South Carolina. Large numbers of adults of *Protoparce sexta* (Joh.) and *P. quinquemaculata* (Haw.) were captured in bait-traps in which the appearance and odour of jimson weed [*Datura stramonium*] were simulated and in electric-light traps of various designs, but only 21 per cent. of *P. sexta* caught in light-traps and 38 per cent. caught in bait-traps in North Carolina were females, although the sexes are present in nearly equal numbers. The corresponding percentages were 50 and 44 for *P. quinquemaculata*. It appeared, therefore that most of the females of the more important species on tobacco are not caught in traps, and field studies indicated that their use had little effect on the abundance of *Protoparce* larvae.

Guthrie (F. E.) & Decker (G. C.). **The Effect of Humidity and other Factors on the Upper Thermal Death Points of the Chinch Bug.**—*J. econ. Ent.* **47** no. 5 pp. 882–887, 3 figs., 12 refs. Menasha, Wis., 1954.

The following is based on the authors' summary. The survival of adults of *Blissus leucopterus* (Say) was studied in the laboratory at eight temperatures between 41 and 55°C. [105·8 and 125·6°F.] and at relative humidities of 10, 28, 55, 76 and 92 per cent. At a temperature of about 50°C. [122°F.], the time required for 50 per cent. mortality was not affected by relative humidity, whereas it was increased by high humidities at lower temperatures and by low humidities at higher temperatures. Providing the bugs kept at temperatures below 50°C. with food as a source of moisture doubled the survival period at high humidity and multiplied it by 25 at low humidity; survival was then favoured by low humidity and there did not appear to be an equilibrium point. Both replacement of lost moisture and cooling appeared to be important factors in the increased survival period with feeding. Water-loss studies indicated that desiccation became progressively less important as a cause of death as humidity and temperature rose.

Shaw (J. G.) & Lopez D. (F.). **Ethylene Dibromide as a Fumigant for Mangoes infested with the Mexican Fruit Fly.**—*J. econ. Ent.* **47** no. 5 pp. 891–893, 1 graph, 10 refs. Menasha, Wis., 1954.

Investigations were carried out in Mexico City in 1951 and 1952 to develop a fumigation treatment with ethylene dibromide against *Anastrepha ludens* (Lw.) in mangos, as an alternative to the vapour-heat treatment required before these fruits are admitted into the United States [*cf. R.A.E.*, A **41** 13]. About 60 lb. fruit, occupying 2·46 cu. ft., was fumigated at a time on trays in metal drums of 7·4 cu. ft. capacity at temperatures of 74–80°F. and then stored over a mixture of sand and sawdust for the recovery of larvae or puparia. The loss of ethylene-dibromide gas by sorption was measured by its recovery in monoethanolamine [*cf.* **40** 172]; only 11 per cent. was recovered from a dosage of 8 oz. per 1,000 cu. ft. applied to the load of fruit. Fumigation for 30 minutes with 4, 8, 12, 16 or 20 oz. gas per 1,000 cu. ft. resulted in the survival of 655–4 out of an estimated population

of 75,650 eggs and larvae, and fumigation for one hour with 4 and 8 oz. in that of 392 and 21, respectively, out of a population of 81,681. Treatment with 1 lb. ethylene dibromide for 15–120 minutes resulted in one survivor at 15 minutes out of 129,141 eggs and larvae, and in 23 experiments with dosages of 2–24 oz. per 1,000 cu. ft. for 2 hours, no eggs or larvae survived treatment with more than 12 oz. The mortality percentages from these tests plotted in probits showed a linear regression.

Fumigation with 16 or 24 oz. ethylene dibromide for two hours at about 77°F. had no effect on the flavour or appearance of ripe Manila mangos or on their ascorbic-acid content, and treatment was authorised on 24th April 1953 as a requirement for their entry into the United States.

GRANOVSKY (A. A.) & PETERSON (A. G.). **Evaluation of Potato Leaf Injury caused by Leafhoppers, Flea Beetles, and Early Blight.**—*J. econ. Ent.* **47** no. 5 pp. 894–902, 3 figs., 26 refs. Menasha, Wis., 1954.

The following is based on the authors' summary. Investigations in Minnesota showed that measurement of the insect injury to potato leaves provides a useful evaluation of insecticides and supplements the information obtained from population counts and yields. There were significant correlations among populations of *Epitrix cucumeris* (Harris), numbers of leaf holes per square inch, and yields; an almost constant relation existed between *Epitrix* counts and numbers of leaf holes, and the latter are believed to provide an efficient estimate of population, whereas relatively large *Epitrix* populations are apparently necessary to cause measurable reductions in yield. Fewer examples of *Empoasca fabae* (Harris) than of *Epitrix* were required to cause measurable yield reductions. The degree of hopperburn is believed to be a fairly accurate index to the *Empoasca* population on a single susceptible variety of potato, but if different or leafhopper-resistant varieties are involved, it cannot be used to indicate either population or reduction in yield. Early blight, caused by *Alternaria solani*, was sufficiently abundant in one field to show a significant negative correlation with yield. Estimates of foliage injury for this as well as for insects should be made within a week or ten days after the final application of insecticides, before the symptoms become complicated by signs of maturity and late attack by insects and disease.

The matching method, with the use of mathematically calculated diagrams for comparison, is an accurate and rapid means of estimating the percentage of foliage injury caused by *Epitrix*, *Empoasca* and early blight. Since evaluations are recorded directly in terms of percentage leaf injury, it may facilitate studies of the relative importance of the different types of damage.

DE PIETRI-TONELLI (P.) & MARCH (R. B.). **Relation of the Activation of Schradan in Plant Tissues to its Toxicity to Insects and Mites.**—*J. econ. Ent.* **47** no. 5 pp. 902–908, 2 graphs, 22 refs. Menasha, Wis., 1954.

The authors review literature showing that schradan is metabolised to an active anticholinesterase agent in plants, mammals and insects [*cf. R.A.E.*, A **42** 382], and describe investigations with insects and a mite to compare the toxicity of unmetabolised schradan with that of schradan after contact with plant or mammalian tissue. The highly purified compound proved to be appreciably toxic by direct contact or ingestion to first-instar nymphs of *Aphis medicaginis* Koch, adults of *Paratetranychus* (*Metatetranychus*) *citri*

(McG.), and third- or fourth-instar larvae of *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.), and a comparative test showed that samples of technical schradan, purified schradan and schradan prepared from radioactive phosphorus ($P^{32}$) had median lethal dosages in 48 hours for the mosquito larvae of 49, 35 and 28 parts per million, respectively, indicating that toxicity is directly related to purity.

In tests with the Aphid, schradan was introduced into bean leaves by an infiltration technique or by translocation. For infiltration, a mature leaf removed from the plant was put into a water solution of schradan in a suction flask, and this was evacuated to 12–15 cm. mercury and restored to normal pressure repeatedly until the solution had penetrated uniformly into the leaf, which was weighed before and after treatment to determine the amount absorbed. For translocation, radioactive schradan was applied to the cut stem, whence it was translocated to the leaves, and the concentration of schradan and metabolites in the latter was determined from the radioactivity. Concentrations of 270 and 320 mmg. per gm. leaf tissue, obtained by the two methods, resulted in 60 and 65 per cent. mortality of the Aphid, respectively, after 48 hours; there was much better correlation between toxicity and the total content of radioactive compounds in the leaves than between toxicity and the amount of schradan metabolised, as shown by the partition coefficients of the extracted radioactive compounds between chloroform and sodium hydroxide [*cf.* **41** 201]. Further tests with *A. medicaginis* showed no apparent difference in the toxicity of bean leaves immediately or 24, 48 or 72 hours after infiltration with schradan, and water solutions of schradan or of homogenates of infiltrated leaves of corresponding schradan concentration, the latter prepared immediately, 24 or 72 hours after infiltration, were equally toxic to the mosquito larvae, indicating that leaf tissue has no activating effect on schradan. Further, solutions of schradan activated by incubation with mouse-liver slices for 0·5, 1 and 2 hours and unincubated solutions showed no marked difference in toxicity to *P. citri*. These results indicate that small quantities of the activated metabolite, when ingested with considerably larger quantities of unchanged schradan, are relatively unimportant as regards toxicity and suggest that only the schradan that is activated by the insect or mite is effectively toxic to it [*cf.* **42** 382].

Measurement of the amounts of schradan ingested by the Aphid and mite was not possible, but observations on the mosquito larvae in solutions of radioactive schradan showed that after 22 and 44 hours, living and dead examples contained similar amounts of schradan and that these were proportional to the concentration of the solution and to the mortality caused. The partition between chloroform and sodium hydroxide of schradan and metabolites extracted from larvae that had been exposed to a solution of 60 p.p.m. schradan for up to 24 hours and were then killed showed that the larvae absorbed amounts that increased with time and transformed it into metabolites partitioning in favour of sodium hydroxide almost as rapidly as it was absorbed; even at the earliest sampling time, very little intact schradan was recovered. Pupae of the mosquito that were exposed to a stronger solution absorbed only very small amounts of schradan, but again rapidly metabolised it. This may indicate that the principal mode of entry into the larvae is by ingestion.

Snapp (O. I.). **Experiments on Control of Georgia Peach Pests in 1953.**— *J. econ. Ent.* **47** no. 5 pp. 909–912, 3 refs. Menasha, Wis., 1954.

In investigations in 1953 on the control of insects attacking peach in Georgia, wettable-powder sprays were applied at petal-fall, shuck-fall, two

weeks after shuck-fall and four and two weeks before harvest for the control of *Conotrachelus nenuphar* (Hbst.). Spray quantities are given per 100 U.S. gals. In large-plot tests, two applications of 1 lb. 25 per cent. dieldrin followed by three of 2 lb. 15 per cent. parathion and three of dieldrin followed by two of parathion resulted in 106 and 98 dropped fruits, respectively, between 20th and 29th April, of which 0·9 and 4·1 per cent. were infested, and in 0·2 and 0 per cent. fruit infestation at harvest, five of parathion and of 1·5 lb. 25 per cent. EPN [ethyl p-nitrophenyl thionobenzenephosphonate] resulted in 117 and 131 dropped fruits, respectively, of which 4·3 and 4·6 per cent. were infested, and in 1·1 and 0·1 per cent. infestation at harvest, and four of 2 lb. lead arsenate (the last application being omitted) resulted in 265 dropped fruits, of which 47·2 per cent. were infested, and in 4·4 per cent. infestation at harvest. The numbers of first-generation adults per tree were 0·06–0·19 after treatment with the organic insecticides, as compared with 2·31 for lead arsenate.

In single-tree plots, the same treatments with organic insecticides and four applications, the last four weeks before harvest, of 2 lb. 25 per cent. wettable dieldrin, aldrin, heptachlor or CS-728 (1-p-chlorophenyl-2-nitro-1-phenylbutane) and of 1 U.S. quart of an emulsion concentrate containing 18·5 per cent. endrin resulted in 0–1·1 per cent. infested fruits at harvest, and four of 2 lb. lead arsenate, 25 per cent. wettable CS-708 [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] or 50 per cent. wettable p,p′methoxy-DDT (methoxychlor) in 3·1, 1·9 and 1·5 per cent., as compared with 7·5 per cent. for no treatment. Residue analysis showed no aldrin, heptachlor or endrin on the fruits at harvest and 0–0·4, 0·4, 0·3 and 1·1 parts per million of dieldrin, CS-708, CS-728 and methoxy-DDT, respectively. The flavour of the ripe peaches was not affected, and there appeared to be no injury to any part of the tree from the organic sprays; lead arsenate caused slight injury to fruits and foliage, even with zinc sulphate and lime as safeners. Five applications of 15 per cent. parathion at 2 lb. with a power sprayer and at 8 lb. with a mist blower resulted in 117 and 337 dropped fruits, respectively, between 20th and 29th April, of which 4·3 and 56·4 per cent. were infested, and in 1·1 and 4·1 per cent. fruit infestation at harvest; the numbers of first-generation adults per tree were 0·19 and 2.

In cage tests, a spray of 2 lb. 25 per cent. wettable Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate] killed no overwintered adults for 24 hours, but 72 per cent. within four days, and one of 4 lb. killed 68 per cent. within the same period. When the adults were exposed to deposits four days old, the second spray killed only 56 per cent. in ten days. At 2 and 4 lb. wettable powder, 25 per cent. malathion killed all the overwintered adults within 24 hours and newly emerged first-generation adults exposed to it 24 hours after application within three days. At 2 lb., it killed all overwintered adults in two days after weathering for six days and 52 per cent. of them in three days after weathering for eight, and all first-generation adults in three days after weathering for four and 72 per cent. of them in five days after weathering for seven; deposits of 2 lb. parathion were nearly as effective as those of 4 lb. malathion against adults of the first generation. When larvae were allowed to enter soil treated in 1952 [*cf. R.A.E.*, A **41** 284] between 23rd April and 20th May 1953, 0·2, 0, 1·4 and 0·7 per cent. of them gave rise to adults in soil treated with 2 and 4 lb. aldrin and 2 and 4 lb. dieldrin per acre, respectively, as compared with 47·8 per cent. in untreated soil. No adults emerged in soil treated in the spring of 1953 with 25 per cent. wettable heptachlor, as compared with an emergence of 0·5 per cent. in that treated with 0·5 per cent. isodrin dust, both at the rate of 4 lb. toxicant per acre.

In tests against *Aegeria* (*Sanninoidea*) *exitiosa* Say, spraying the trunks of peach trees with 4·8 lb. 10 per cent. γ BHC, 5·5 lb. 75 per cent. DDT or 2 lb. 15 per cent. parathion on 1st–4th August, 2nd–3rd and 26th September and 23rd October resulted in no living larvae in trees two years old and in 0·12, 0·68 and 0·75 per tree in those five years old, whereas applying ethylene-dichloride and trichlorobenzene emulsions as fumigants to the bases on 24th and 27th October resulted in 0·04 and 0 on the young and 0·32 and 0·04 on the older trees; untreated trees showed 0·36 and 7·7 larvae per tree, respectively. Applications of 8 lb. 6 per cent. γ BHC or 4·8 lb. 10 per cent. γ BHC to nursery stock on 1st and 31st July, 1st September and 1st October 1952 resulted in no infestation in January 1953, whereas 3 lb. 15 per cent. parathion and no treatment resulted in 3·4 and 5·2 per cent. of infestation, respectively. Spraying injured areas of peach trees heavily infested by *A.* (*Synanthedon*) *pictipes* (G. & R.) on 17th April, 16th May, 15th August and 15th September 1952 resulted in 2·5, 1·6 and 0·8 living larvae per treated area for 5·3 lb. 75 per cent. DDT, 8 lb. 6 per cent. γ BHC and 3 lb. 15 per cent. parathion, respectively, as compared with 3·2 for no treatment.

Smith (E. H.) & Avens (A. W.). **The ovicidal Action of Parathion in Control of the Peach Tree Borer.**—*J. econ. Ent.* **47** no. 5 pp. 912–917, 2 figs., 6 refs. Menasha, Wis., 1954.

In further work on the control of the peach tree borer [*Aegeria exitiosa* Say] and the lesser peach tree borer [*A. pictipes* (G. & R.)] on peach in New York [*cf. R.A.E.*, A **41** 75], investigations were made on the distribution of the eggs on the trunk, with a view to determining the spray coverage necessary for maximum ovicidal effect. The eggs of *A. pictipes* are deposited along the margin of wounds occurring on any part of the bark, though chiefly on the scaffold branches, and adequate coverage is usually given by foliage treatments, whereas those of *A. exitiosa* are deposited chiefly on the trunk and are not necessarily reached by foliage sprays. Counts of eggs deposited 0–6, 6–12 and 12 ins. or more above soil level on prune trees 15 years old and on peach trees five and 20 years old, of which the first two have smooth and the third rough bark, showed that on all trees more than 70 per cent. were deposited within six inches of the soil. This part of the trunk is the most difficult to cover with spray, owing to low-hanging branches and other vegetation, and existing spray practices therefore need modification.

The average number of females of *A. exitiosa* that emerged from the young peach trees, based on collection of pupal cases, was 3·4 per tree and the number of eggs found 125·7, indicating an average of only 36·9 per female [*cf.* **32** 219]. The lowness of this figure may have been due to an unsuitable method of counting, to the deposition of fewer eggs under natural conditions than in confinement, or to the deposition of a smaller proportion of the eggs on the trunks than has been assumed.

In tests in 1952–53, to determine the duration of the ovicidal effect of parathion and the exposure required for effective action, young peach trees were thoroughly sprayed with 2 lb. 15 per cent. wettable parathion per 100 U.S. gals. Samples of leaf and bark were collected at intervals, for residue determination, and newly emerged fertilised females caged individually on the trees. Samples of eggs were removed from the sprayed surface from time to time during the incubation period, which lasted 12 or more days, and kept in an insectary. Some egg mortality resulted from all exposures of two days on residues less than eight days old and of four days on residues 8–13 days old, and complete mortality after exposure for 6, 8

and 10 days to residues up to 5, 8 and 13 days old, respectively, whereas residues 23 days old caused no mortality after exposure for 2–10 days. Residues five days old were slightly more effective than those 1–2 days old. In all cases of mortality, the embryos developed apparently normally to the point of hatching but failed to emerge from the chorion. Analysis showed that there was three times as much initial residue on bark as on leaves and that it weathered much more slowly, being less affected by rain.

Michelbacher (A. E.) & Middlekauff (W. W.). **Vinegar Fly Investigations in Northern California.**—*J. econ. Ent.* **47** no. 5 pp. 917–922, 2 graphs, 4 refs. Menasha, Wis., 1954.

The following is based on the authors' introduction and summary. *Drosophila melanogaster* Mg. is a troublesome pest of tomatos in northern California. The most serious infestation of the fruits in tomato fields was found in regions in which there were large plantings of fruit trees, and it is believed that it resulted from the migration of the flies from peach orchards that had been harvested. Low light intensities and temperatures higher than 13°C. [55·4°F.] are necessary for adult flight, but localised movement takes place when conditions are not favourable for extended migration. Experiments with various natural baits in 1952 and 1953 showed that their relative attractiveness to the adults was not constant. When slit tomatos on which the flies could oviposit were used, the highest deposition of eggs occurred when conditions were most favourable for adult activity. The lower limit of temperature for oviposition was close to 13°C.; the upper limit was not determined, but experimental evidence indicated that it must be well above 30°C. [86°F.]. Egg deposition continues at a decreased rate during periods of heavy wind, when the adults seek shelter.

The cool conditions that existed late in the season did not favour migration of the adults to boxes of picked tomatos that were stacked and left in the field. Major migrations occurred only in the late afternoon, when both temperature and light intensity were favourable, but the adults were attracted to baits and slit tomatos at all hours of the day, and the fly population did not remain constant, even in heavily infested fields. The highest population densities probably follow picking, when much fruit is squashed or otherwise mutilated.

Of the insecticidal treatments tested, dieldrin applied by aeroplane at the rate of 1 lb. toxicant in 10 U.S. gals. water per acre showed the most promise, but further tests in warmer weather are required before recommendations can be made. A 10 per cent. dust of Q-137 [1,1-bis(p-ethylphenyl)-2-dichloroethane (ethyl-DDD)] at 30 lb. per acre and a malathion emulsion concentrate applied at 2·5 lb. malathion with 8 lb. sugar in 16 U.S. gals. water per acre also showed promise.

Lindgren (D. L.), Vincent (L. E.) & Krohne (H. E.). **Relative Effectiveness of ten Fumigants to Adults of eight Species of Stored-product Insects.**—*J. econ. Ent.* **47** no. 5 pp. 923–926, 3 refs. Menasha, Wis., 1954.

In the tests described, adults of *Bruchus* (*Acanthoscelides*) *obtectus* Say, *Spermophagus subfasciatus* Boh. (*Zabrotes pectoralis* (Sharp)), *Stegobium* (*Sitodrepa*) *paniceum* (L.), *Calandra* (*Sitophilus*) *granaria* (L.), *C.* (*S.*) *oryzae* (L.), *Tribolium confusum* Duv., *Oryzaephilus surinamensis* (L.) and *Rhizopertha dominica* (F.) were exposed to various fumigants at temperatures of 69–71°F. in gas-tight metal chambers 100 cu. ft. in capacity with continuous

circulation of air within them. After fumigation, the insects were provided with food and moisture and kept at a temperature of 78°F. and 70 per cent. relative humidity for four days before mortality counts were made. Each compound was applied at 6–10 rates, and the results were plotted on graphs, from which the dosages causing 50 and 95 per cent. mortality were estimated. Comparison of those giving 95 per cent. kill showed that, for exposures lasting two hours, *C. granaria* was the most generally resistant insect, followed by *T. confusum*, *S. paniceum*, *C. oryzae*, *R. dominica*, *B. obtectus*, *O. surinamensis* and *Spermophagus subfasciatus*, *R. dominica* and *B. obtectus* being equally susceptible. For exposures lasting six hours, the order of resistance was the same, except that *B. obtectus* was more resistant than *C. oryzae* and *Spermophagus* was equal to *Oryzaephilus*. The order of general toxicity of the fumigants to all insects was acrylonitrile followed by hydrogen cyanide, chloropicrin, ethylene dibromide, methyl bromide, ethylene oxide, ethylene chlorobromide, methallyl chloride, carbon bisulphide and ethylene dichloride for the two-hour exposures and the same, except that ethylene dibromide and methyl bromide reversed their positions, for the six-hour exposures. These results do not indicate order of resistance to any specific fumigant or order of toxicity to any one insect species.

Ryckman (R. E.) & Christianson (C. P.). *Acheta assimilis* **F. parasitized by** *Paragordius varius*.—*J. econ. Ent.* **47** no. 5 p. 926, 1 ref. Menasha, Wis., 1954.

A female of *Acheta assimilis* F. taken in a house in California and killed was found to be parasitised by a worm, identified as *Paragordius varius*. The cricket was 2·6 cm. long, and the worm, which extruded from the abdominal cavity, was 42·7 cm. long.

Ricker (D. W.) & Fleschner (C. A.). **An Eriophyid Mite new to Avocados in California.**—*J. econ. Ent.* **47** no. 5 p. 926. Menasha, Wis., 1954.

An Eriophyid collected in large numbers from the lower surfaces of the leaves of an avocado tree at Ventura, California, in February 1954 was identified as *Calepitrimerus mueseebecki* Keifer, which had not previously been observed outside its type locality in Florida, where it was described from avocado. The tree had been sprayed with 2 lb. 20 per cent. wettable Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] per 100 U.S. gals. in August 1952 and August 1953. An unidentified mite of the genus *Mediolata* was observed feeding on the Eriophyids.

Bigger (J. H.) & White (C. E.). **Clover Leaf Weevil Control by Fall Insecticide Applications.**—*J. econ. Ent.* **47** no. 5 pp. 927–928. Menasha, Wis., 1954.

In the course of investigations on the control of *Philaenus leucophthalmus* (L.) on red clover in Illinois in 1951, it was found that the application of a spray affording 1·5 lb. DDT per acre in September gave 95·8 per cent. reduction in the numbers of larvae of *Hypera punctata* (F.) by May 1952. Similar sprays applied on 26th August or 2nd, 3rd, 8th or 15th September 1952, to test time of application, all gave about 90 per cent. or more reduction in mixed fields of lucerne and red clover by April 1953, whereas 0·25 lb. parathion per acre gave no control of the weevil, and reduced that given by DDT when added to it. Spring applications of 0·2 lb. γ BHC per acre were slow in action but eventually gave fair control.

Babers (F. H.), Roan (C. C.) & Walker (R. L.). **Tagging Boll Weevils with Radioactive Cobalt.**—*J. econ. Ent.* **47** no. 5 pp. 928–929, 6 refs. Menasha, Wis., 1954.

Radio-isotopes are commonly used for marking insects, and as studies of the overwintering habits of *Anthonomus grandis* Boh. made it necessary to mark several thousand adults with a material that would still be appreciably radioactive at least five months after application, the suitability of radioactive cobalt ($CO^{60}$) was investigated. A stock solution was prepared by diluting 5 millicuries of $CO^{60}$ as the chloride dissolved in 0·2 ml. 0·34 N hydrochloric acid to 10 ml. with distilled water, and 2 ml. was further diluted with water to 200 ml. for a working solution, which was found to have a specific activity of $6{\cdot}6 \times 10^5$ counts per minute per ml. Adults were dipped in this, caged for five days and then killed and examined for radioactivity before and after being shaken vigorously for one minute in water. The same tests were carried out with working solutions to which small quantities of wetting agents had been added, and it was found that Tergitol 7 (sodium sulphate derivative of 3,9-diethyltridecanol-6) was the most effective of these, the radioactivity before and after washing being 4,690 ± 718 and 3,523 ± 703, respectively, when one drop (18·8 mg.) was added to 50 ml. working solution, as compared with 710 ± 122 and 346 ± 37 when no wetting agent was used.

When the stem of a small portion of a growing cotton plant was immersed in a solution of the salt, it was several hours before appreciable radioactivity was present in the leaves [*cf. R.A.E.*, A **42** 15]. After 24 hours, all parts of the plant were radioactive, especially the cotton in the immature bolls, and more of the cobalt had disappeared from the solution than was accounted for by the uptake of water.

Faulkner (L. R.). **Effects of certain Insecticides upon unhatched Larvae of the Pale Western Cutworm in the Laboratory.**—*J. econ. Ent.* **47** no. 5 pp. 929–930, 2 refs. Menasha, Wis., 1954.

The pale western cutworm [*Agrotis orthogonia* Morr.] injures winter wheat in New Mexico over periods of about three years that occur in cycles of 7–10 years, and 40–60 per cent. of the crop was destroyed in 1948–51. Since the eggs, which are laid on the soil, complete their development fairly rapidly but do not hatch until temperature and moisture conditions are favourable, nine insecticides were compared for toxicity to the unhatched larvae in the laboratory in 1952–53. Eggs deposited by females collected at light in September were allowed to develop for ten days at 75–80°F., which was sufficient for the larvae to reach the hatching stage, and were then sprayed with diluted emulsion concentrates and stored in the insectary under the prevailing atmospheric conditions until April. Examination then showed that 25 per cent. DDT or DDD (TDE) at a dilution of 1:100 failed to produce significant mortality of the unhatched larvae, as compared with no treatment; 20 per cent. lindane (almost pure γ BHC), 23 per cent. aldrin, 15 per cent. dieldrin and 50 per cent. malathion at 1:200 produced 81, 70, 64 and 59 per cent. mortality, respectively, and 50 per cent. Metacide [methyl-parathion and parathion] or demeton [diethyl 2-(ethylmercapto)-ethyl thiophosphate] and 25 per cent. parathion at 1:400 caused 73, 67 and 52 per cent. As winter wheat in eastern New Mexico is usually sown before the eggs hatch, the possibility of applying an insecticide at sowing time is suggested.

Osburn (M. R.). **EPN for Control of the Hickory Shuckworm on Pecan.** —*J. econ. Ent.* **47** no. 5 p. 931, 1 ref. Menasha, Wis., 1954.

*Enarmonia* (*Laspeyresia*) *caryana* Fitch is an important pest of pecan in central and southern Georgia, the larvae destroying the immature nuts from May until August and tunnelling in the husks, after these have hardened, from August until late autumn. Multiple treatment with insecticides gives some control, but is expensive, and in 1952, applications of EPN [ethyl p-nitrophenyl thionobenzenephosphonate] at different periods during the nut-growing season were compared. The results showed that three sprays of 2 lb. 25 per cent. wettable EPN per 100 U.S. gals., applied on 8th and 21st August and 3rd September, after the husks had hardened, were at least as effective as any other schedule. In 1953, EPN was applied at the same concentration on 6th and 19th August and 2nd September, on the first two dates only and on the last two only, and at half the concentration on all three dates. All treatments caused a significant reduction in husk infestation at harvest and significant increases in the weight of the nuts and the percentage weight of kernels in them. Three applications at the higher concentration gave the greatest reduction in husk infestation and the highest percentage weight of kernels and resulted in a higher percentage of oil in the kernels than no treatment; the yield of oil was not measured for the other treatments. The two late applications reduced husk infestation significantly more than the two early ones, but not significantly more than three applications at the lower concentration; no other differences were significant. The Aphid, *Melanocallis caryaefoliae* (Davis), and the mite, *Tetranychus hicoriae* McG., developed on unsprayed trees to a greater extent than on those sprayed with EPN.

Struble (G. R.) & Hall (R. C.). **Telephone Cables invaded by Shrub Bark Beetle in Pacific Coastal Region.**—*J. econ. Ent.* **47** no. 5 pp. 933–934, 2 figs., 1 ref. Menasha, Wis., 1954.

Adults of *Micracis hirtellus* Lec., which had twice been reported since 1927 attacking the lead covering of telephone cables in California, were found to have damaged a newly developed substitute covering of polyethylene plastic in June 1951, when a five-mile section of new pressurised cable showed about 25 holes per yard. These penetrated through the plastic to the cable within, reducing the pressure in the sheath and allowing the entrance of moisture, which threatened to cause short circuits in the system. The wires were not attacked. The bark-beetles had spread from *Rhamnus purshiana*, from which bark had been harvested for medicinal purposes, and from willow (*Salix*), in which they normally breed. They have been recorded from the coastal regions of California in the last 40 years as breeding in the dead or dying stems of various shrubs and small trees, and there appears to be at least one generation a year. Since 1951, damage by the Scolytid to polyethylene-covered cables has occurred in several localities in California.

Harrison (F. P.), Ditman (L. P.) & Bickley (W. E.). **Habits of *Drosophila* with Reference to Animal Excrement.**—*J. econ. Ent.* **47** no. 5 p. 935, 3 refs. Menasha, Wis., 1954.

An account is given of observations made in view of a suggestion that species of *Drosophila* are attracted to human excrement and might be concerned in the transmission of disease. Traps baited with faeces of man, dog, horse, cow and fowl and others baited with tomato and banana and some

unbaited ones were exposed for six days in September–October in a tomato field on a farm in Maryland. In five daily counts of the catch, 553 and 571 adults of *Drosophila* (of which 96 per cent. were *D. melanogaster* Mg. and 2 per cent. *D. affinis* Sturt.) were taken in the traps baited with banana and tomato, respectively, but none in any of the other traps. The tomato ceased to be attractive once decay had set in. The authors consider that the statement that adults of *Drosophila*, particularly those of *D. melanogaster*, are attracted to decaying fruits and vegetables and breed in them is misleading. They are primarily attracted to fresh and fermenting fruits and vegetables where the fermentation is caused by the presence and multiplication of yeasts.

Newton (R. C.). **New Records of Dipterous Parasites of Grasshoppers.** —*J. econ. Ent.* **47** no. 5 pp. 935–936, 1 ref. Menasha, Wis., 1954.

Examination of parasitised grasshoppers found in Montana and North Dakota in 1952–53 revealed the presence of larvae of the Anthomyiid, *Acridomyia canadensis* Snyder, in adults of *Camnula pellucida* (Scud.), *Melanoplus mexicanus* (Sauss.) and *M. bruneri* Scud. between 28th July and 25th September in both years in Montana; 28 per cent. of the adults of *C. pellucida* were parasitised in Park County on 14th August 1953, and as many as 27 larvae were found in one grasshopper. The Tachinid, *Ceracia dentata* (Coq.) was found in an adult of *M. packardii* Scud. in Montana in 1952, and a larva that was probably of this species occurred in an overwintering nymph of *Psolocssa delicatula* (Scud.) in April 1953 in North Dakota. It was found in two counties of Montana in 1953; larvae were present in adults of *Camnula pellucida*, *M. confusus* Scud. and *M. bruneri* and in a third-instar nymph of *M. bivittatus* (Say) between 9th July and 9th September. Adults of *C. pellucida* were preferred, about 3 per cent. being parasitised between 5th and 14th August. The Tachinid, *Hemithrixion oestriforme* Br. & Berg., was observed in Montana in 1953 in older nymphs and adults of *M. bruneri* and to a less extent in adults of *C. pellucida* from 24th July to 25th September 1953, when larvae were also found in one adult each of *M. bivittatus* and *Boopedon nubilum* (Say). Parasitism reached 11 per cent. in *M. bruneri* on 17th September, and as many as four larvae were present in one grasshopper. A third Tachinid, *Acemya tibialis* Coq., was obtained from one fifth-instar nymph and one adult of *M. bruneri* in Montana in 1953 and is apparently of minor importance as a grasshopper parasite.

Dean (F. P.) & Newcomer (E. J.). **Methoxychlor for Codling Moth Control.** —*J. econ. Ent.* **47** no. 5 pp. 936–937, 1 ref. Menasha, Wis., 1954.

Comparisons were made in 1950–53 of sprays of 50 per cent. wettable p,p′methoxy-DDT (methoxychlor) and 50 per cent. wettable DDT, used at the same concentrations (1–2 lb. per 100 U.S. gals.) and in the same numbers of sprays, for the control of *Cydia* (*Carpocapsa*) *pomonella* (L.) on apple at Yakima, Washington. Parathion was added to both as an acaricide in the first three years, and malathion and DMC [1,1-bis(p-chlorophenyl)-ethanol] to methoxy-DDT and sulphur to DDT in the fourth. In five tests in 1950, 1952 and 1953, there was very little difference in control, the percentages of fruits infested and fruits showing injury at harvest averaging 5·2 and 10·9, respectively, for methoxy-DDT and 5·1 and 13·7 for DDT. In 1951, both materials failed to give such good control, probably because only three poorly timed applications were made over a long season, and

the percentages infestated and injured were 31·9 and 36 for methoxy-DDT and 44·4 and 50·5 for DDT, indicating that methoxy-DDT is possibly somewhat longer lasting than DDT. It has not been tested in areas of heavy rainfall. Various other acaricides were also used with methoxy-DDT, with no evidence of injury to fruit or foliage, showing that the compound is compatible with many other toxicants.

Wilcox (J.) & Howland (A. F.). **Tests with DDT and other Insecticides for Control of the Cabbage Looper in southern California.**—*J. econ. Ent.* **47** no. 5 pp. 937–938. Menasha, Wis., 1954.

As DDT was reported as having failed to control caterpillars on cabbage and cauliflower in southern California in the autumn of 1952, it was compared with other insecticides against *Trichoplusia ni* (Hb.), the only species causing serious injury, on cauliflower. Dusts were applied at about 40 lb. per acre on 8th and 28th October and 6th November, and examination on 13th and 20th November showed that 5 and 10 per cent. DDT and 5 per cent. DDT with 2 per cent. parathion reduced the total damage rating by 24, 59 and 83 per cent., respectively, whereas 5 and 10 per cent. toxaphene, 2 per cent. parathion, 5 per cent. malathion and 2 per cent. Metacide [methyl-parathion and parathion] reduced it by 64, 86, 73, 74 and 80 per cent., respectively. All the dusted plants showed less damage than untreated ones; 5 per cent. DDT was significantly inferior to the other dusts, and 10 per cent. toxaphene, DDT with parathion, and Metacide were significantly better than 10 per cent. DDT or 5 per cent. toxaphene.

In 1953, five applications were made to turnips infested by *T. ni* at weekly intervals between 4th August and 2nd September, and examination on 9th September showed that 5 per cent. DDT and 4 per cent. Diazinon (O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate) caused 63 and 66 per cent. reduction in the numbers of holes per leaf and were significantly inferior to 10 per cent. toxaphene, 5 per cent. DDT with 2 per cent. parathion, and 2 per cent. parathion, which gave 96, 95 and 92 per cent. reduction.

Doucette (C. F.). **Recurrence of the Satin Moth in the Pacific Northwest.** —*J. econ. Ent.* **47** no. 5 pp. 939–940, 3 refs. Menasha, Wis., 1954.

Serious defoliation due to *Stilpnotia salicis* (L.) was common on poplars [*Populus*] and willows [*Salix*] in western Washington and the Willamette Valley of Oregon until 1935, when the parasite, *Apanteles solitarius* (Ratz.), which had been introduced in 1929–34, became widespread and abundant [*cf. R.A.E.*, A **26** 590]. The decrease in the moth was more marked in 1936, and its numbers remained negligible until June 1953, when defoliation of native cottonwood trees [*Populus*] was observed in the Puyallup Valley of Washington. In July, adults were observed round lights in the early evening. This appears to be the first recurrence of the moth in appreciable numbers in the area since 1935.

Summerland (S. A.) & Hamilton (D. W.). **A Leaf Roller, *Platynota flavedana* Clem., attacking Peaches.**—*J. econ. Ent.* **47** no. 5 p. 941, 9 refs. Menasha, Wis., 1954.

Larvae found feeding on peach in southern Indiana for the first time in 1948 were at first thought to be those of *Eulia* (*Argyrotaenia*) *velutinana*

(Wlk.), but no overwintering pupae could be found in the spring of 1950 in orchards that had been heavily infested in 1949, and a larva that was reared in 1950 proved to be *Platynota flavedana* Clem. This Tortricid also injured peach in southern Indiana, Illinois and Kentucky in 1953 and attacked apple in Indiana, though not seriously. Some of the larvae were infected by a granulosis virus, and one was parasitised by the Tachinid, *Anachaetopsis tortricis* (Coq.).

Stevenson (W. A.) & Kauffman (W.). **The Cotton Leaf Perforator and its Control in the Southwest.**—*J. econ. Ent.* **47** no. 5 pp. 941–942. Menasha, Wis., 1954.

*Bucculatrix thurberiella* Busck was widespread on cotton in Yuma, Maricopa and Pinal Counties, Arizona, and in southern California in 1953. During the summer, the moths oviposit on the leaves or bolls, and the eggs hatch in 3–4 days. The first-instar larvae mine the leaves or bolls for 2–5 days, and those in the second and third instars feed externally for 1–2 and about 2 days, respectively, with a period of 1–1·5 days in between. The pupal stage lasts 5–7 days and is spent on or near the plant. There may be many generations in a season, and control is difficult because of the shortness of the two external feeding stages. A Eulophid of the genus *Closterocerus*, which parasitises the larvae in their mines, is the most important natural enemy. Arsenicals did not give satisfactory control when tested in the past, and though a 5 per cent. DDT dust gave complete kill of the external feeding stages within 24 hours in 1945, it was effective only for comparatively short periods. Sabadilla proved ineffective. In tests in Arizona in 1953, 5 per cent. DDT with 15 per cent. toxaphene was superior to DDT alone, a concentrated endrin spray applied to give 0·2 lb. toxicant per acre gave complete kill of the larvae, and a 2 per cent. endrin dust at 20 lb. per acre was nearly as good.

Moreland (C. R.). **A Wind Frame for trapping Insects in Flight.**—*J. econ. Ent.* **47** no. 5 p. 944, 1 fig. Menasha, Wis., 1954.

The author describes and figures a wind frame used to collect adults of *Miccotrogus picirostris* (F.) during observations on the effect of wind on dispersal of this weevil in Ontario in 1952 [*cf. R.A.E.*, A **43** 159]. It is constructed in such a manner that air currents can readily pass between narrow sticky surfaces, instead of being deflected round a wide solid barrier.

Wilcox (J.) & Howland (A. F.). **Comparison of Demeton Dusts and Sprays on Beans and Strawberries.**—*J. econ. Ent.* **47** no. 5 pp. 945–946. Menasha, Wis., 1954.

In field experiments in California, dusts and sprays of demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate] were compared against *Tetranychus bimaculatus* Harvey and *Frankliniella moultoni* Hood on lima beans in 1952 and against *T. bimaculatus* and *Capitophorus fragaefolii* (Ckll.) on strawberry in 1953.

In 1952, demeton applied on 15th August at 11·4, 5·7 and 2·7 oz. per acre in sprays and at 13·9, 7 and 3·5 oz. per acre in dusts caused 99, 97, 93, 96, 92 and 68 per cent. reduction in *T. bimaculatus*, respectively, and 91, 78, 68, 76, 66 and 23 per cent. reduction in *F. moultoni*, sprays proving more effective than dusts and control increasing with dosage. In 1953, demeton applied on 27th March at 13·6, 5·8 and 2·9 oz. per acre in sprays and 12·2,

5·6 and 2·8 oz. per acre in dusts caused 98, 95, 88, 94, 84 and 68 per cent. reduction in *T. bimaculatus* and 99, 97, 97, 99, 97 and 94 per cent. reduction in *C. fragaefolii*. All treatments gave significant control in both tests.

MARTIN (Henri). **Contribution à l'étude de la mouche des fruits (*Ceratitis capitata* Wied.) dans la région d'Alger 1949–1951.**—*Rev. Path. vég.* **32** (1953) fasc. 4 pp. 209–246, 15 figs., 4 refs. Paris [1954]. (With a Summary in English.)

A detailed account is given of observations on the bionomics, host fruits and control of *Ceratitis capitata* (Wied.) near Algiers in 1949–51, the main results of which have already been noticed [*cf. R.A.E.*, A **41** 323]. Field tests on control were carried out on apricot and peach, as well as orange [**41** 324]. On apricot in 1949, a wettable-powder spray containing 0·25 per cent. DDT applied on 1st June, shortly after the adults became numerous, reduced the percentage infestation at harvest, on 17th June, from 53 to 12, and the same spray and an emulsified solution containing 0·1 per cent. DDT similarly applied on 12th June in a mixed orchard reduced it from 53 to 2 on 23rd June and from 73 to 7 and 3, respectively, on 28th June, after which it rose to 24 and 16, respectively, by 1st July. On peaches, the emulsified solution applied on 10th June, shortly after the appearance of the adults, reduced the percentage infestation in one orchard from 40·6 to 2·5 about a fortnight later and from 92 to 13·5 on 30th June, after which it rose rapidly, but even two applications about a fortnight apart failed to protect another planting adequately, owing, as it was thought, to the small number of trees concerned and the occurrence of unusually high temperatures, which are known to increase the resistance of the adults to DDT. The same spray applied at 0·1 per cent. on 24th July and at 0·15 per cent. on 10th and 23rd August to peaches picked on 19th–30th August, reduced the percentage infestation from 84 to 13, the first application proving unnecessary. In the tests on orange, unlike those on apricot, which has downy fruits, the wettable-powder spray of 0·25 per cent. DDT proved superior to the emulsified solution containing 0·1 per cent., and its effectiveness was very slightly increased by the addition of 0·5 per cent. white oil.

SACANTANIS (K. B.). **Méthode d'élevage au laboratoire de la mouche des olives (*Dacus oleae* Gmel.).**—*Rev. Path. vég.* **32** (1953) fasc. 4 pp. 247–257, 4 refs. Paris [1954].

Adults of *Dacus oleae* (Gmel.) have been kept alive in the laboratory for up to nine months, but no method of continuous laboratory breeding has hitherto been available, largely because of the difficulty of providing olives for oviposition at all times of the year. The author kept olives in a suitable condition for up to about six months by disinfecting them in 2 per cent. borax and storing at 4–6°C. [39·2–42·8°F.] and high relative humidity, preferably in a refrigerator, and describes a breeding method that gave good results in Morocco.

Infested olives were placed on sand and the largest of the pupae obtained were transferred just before adult emergence to cages measuring about 20 × 14 × 14 ins., with two sides of wire mesh, two of glass and two of plywood, which accommodated 100–125 pairs of adults each. After emergence, olives suitable for oviposition were suspended in the cages. The fruits were replaced daily, and it was found that about 40 were usually required per 100 females per day, as not more than four larvae could develop normally in each. The infested fruits were kept in wire-mesh baskets over sand under conditions of subdued light and high relative humidity, and the pupae

used for further breeding. Rearing should be carried out at 23–25°C. [73·4–77°F.] with a relative humidity of at least 60 per cent. in the cages. Methods of controlling the temperature and humidity are discussed. The oviposition cage should be well lit, and fluorescent lamps giving a light intensity of 2,000 lux are recommended. The adults fed readily on pieces of banana, date, fig and ordinary sugar, and tomato, orange and other fruits were accepted at times. Water was also required.

The daily rate of production over three years averaged 30 insects per cage containing 125 pairs of adults, though this was somewhat reduced when the stored olives had to be used. There were no differences between the laboratory-reared flies and those taken in the field, even after several generations. The adults were attracted to light, were disturbed if their food was moved from its normal position, and showed individual preferences for a particular kind of fruit. The males were observed feeding at the punctures made by the females in the course of selecting suitable sites for oviposition, and if deprived of suitable fruits, the females laid their eggs on other objects within the cage. In fresh olives at 23–25°C. and a relative humidity of 75 per cent., the egg stage usually lasted 36–48 hours and the larval stage 8–10 days. Factors that caused mortality among the larvae included the presence of more than five in one fruit, poor quality of the stored olives, immaturity of the fresh ones, extreme changes in temperature, and the drying up of the fruits. Under optimum conditions, the pupal stage lasted 8–12 days, but its duration was affected by the quality of the food during the larval stage. Adults fed for at least 2–3 days before becoming sexually mature, and this period was prolonged if food was not provided or was unsuitable.

Jover (H.). **Notes biologiques sur quelques Coléoptères xylophages de Basse-Côte-d'Ivoire. Cerambycidae.**—*Rev. Path. vég.* **32** (1953) fasc. 4 pp. 258–275, 1 ref. Paris [1954].

A list is given of 25 Longicorns that infest felled or living trees, mostly native species, in the lower Ivory Coast, with notes on their distribution, the trees attacked, their natural enemies and associated insects, and their economic importance, which is in most cases slight. The Lamiid, *Coptops aedificator* (F.), is the most abundant of them and is polyphagous, the larvae causing considerable damage to the heartwood of felled saplings and also to posts and poles used in the construction of native huts. Others of importance include the Lamiids, *Ancylonotus tribulus* (F.), which attacks coffee as well as living forest trees, the life-cycle lasting over four months, *Zographus regalis* (Brown), which damages posts, and *Prosopocera bipunctata* (Dru.), which causes severe injury to plantations of *Tarrietia utilis*, the Cerambycid, *Amphidesmus apicalis* (Westw.), which attacked felled logs, and the Prionids, *Mallodon downesi* Hope [*cf. R.A.E.*, A **35** 37], which is polyphagous and breeds in logs and also in living trees attacked by other insects, particularly *Ancylonotus tribulus*, the pupal stage lasting at least 22 days and development being completed in 3–4 months in the laboratory, and *Acanthophorus spinicornis* (F.), which also infests logs.

Pettey (F. W.). **The boring Beetles of Prickly Pear in South Africa and their Importance in the Control of** *Opuntia megacantha*.—*Sci. Bull. Dep. Agric. S. Afr.* no. 340, [1+] 36 pp., 10 figs. Pretoria, 1953.

This account of work in South Africa on the control of the noxious weed, *Opuntia megacantha*, by two introduced beetles, the Lamiid, *Lagochirus*

*funestus* Thoms., and the weevil, *Cactophagus spinolae* (Gylh.), contains descriptions of all stages of both species and the methods adopted for rearing them in large quantities, accounts of their bionomics under cage conditions in South Africa, details of liberations, which were made in sub-coastal areas of Eastern Cape Province where other species had failed to give control [*cf. R.A.E.*, A **36** 171–172], and discussions of the results obtained. During 1943–49, 939,852 adults of *L. funestus* were liberated, but although old plants of *O. megacantha* were destroyed, young ones were not attacked and the Lamiid did not become established [*cf.* **36** 172]. Rearing and liberations were discontinued in 1950, and the insect had practically died out in all areas by 1951.

Warm, humid conditions were found to be most favourable for *C. spinolae*, which was introduced from Mexico in 1946–48 [*cf.* **40** 197]. Females in cages fed and oviposited most freely on the cut ends of branches of *O. megacantha* and fed less readily on young segments; terminal segments were rarely attacked. In the field, the eggs were inserted into the segments. The oviposition punctures became covered by an accumulation of mucilaginous sap, but this had no harmful effect on the eggs or young larvae, since these were situated more deeply than those of *L. funestus* [*cf.* **36** 172]. The larvae burrowed in both woody and old green segments and usually pupated in or near the joints, though many did so in old green segments containing fibres. When adults that emerged in midsummer were caged in the open on branches of *O. megacantha*, pairing continued for 3½ months and oviposition for about five months, though most of it took place during the first 3–4 months. The females survived for 47–406 days, and the males for 34–405. Adults of the next generation emerged about 7–15 months after the beginning of oviposition. In food-plant tests, *O. megacantha* was more suitable than two spineless species of *Opuntia*. A caged plant 8 ft. high, on which 30 pairs of newly emerged adults were released during September–December 1947, was completely destroyed by late February 1949, except for one fallen branch, and that was heavily infested by larvae; only one living adult was found a week later, when mortality in the cocoons present was over 25 per cent. The mortality in 600 cocoons from dead branches collected at sites in the veld where *C. spinolae* had been liberated amounted to 28·3 per cent. During mass rearing, mortality was higher in cocoons formed in winter than those formed in summer. Among 3,700 from which adults failed to emerge during mass rearing, the numbers containing dead larvae, pupae and adults were 2,537, 708 and 455, respectively; over 50 per cent. of the total had been attacked by *Beauveria* sp., but it is not known whether this fungus was the cause of death. When females began ovipositing in the cages in September–November, at least 50 per cent. of their progeny emerged during winter, when oviposition is partly or completely prevented in the field by low temperatures, but over 75 per cent. of the progeny of females that began to oviposit in January–February emerged during the summer. Owing to high mortality in the cocoon stage in generations derived from summer eggs, the rate of increase was almost threefold in one generation, whether the eggs were laid in January–February or in September–November. Mortality of the cocoon stages appears to be caused by wet rot in *O. megacantha* and low temperatures, and it is unlikely that it can be reduced below an average of 25–30 per cent. in any season under the prevailing climatic conditions.

Liberations of *C. spinolae* were begun in March 1948, and 76,761 adults had been released at five places by March 1952. At least 10,000 adults were liberated in heavily infested areas, and large plants received 80–100 each. Progress was slow, though plants on which releases had been made were destroyed and the beetles had spread some 200 yards in 2½ years

at one place and in two at another. It was greatly checked by the unusually low winter temperatures of 1952, and observations in 1953 indicated that the weevil was dying out, mainly because the females that emerged in winter succumbed to the low night temperatures and died without ovipositing.

Lea (A.). **Studies on the Behaviour of Adult Brown Locusts in the Karoo with an Account of the Experimental Painting of Part of an egg-laying Swarm and the subsequent Recovery of marked Individuals.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 344, [2+] 21 pp., 2 figs., 3 refs. Pretoria, 1953.

The following is largely based on the author's summary. The observations described were made during an incipient outbreak of *Locustana pardalina* (Wlk.) in the Karoo desert of South Africa during the early winter of 1938. About two million adults in a swarm in which the females were ready to oviposit were marked by spraying with a yellow oil-bound paste diluted in water, which had good drying and adhesive qualities, and their subsequent movements were followed. Evidence was obtained that the females on an oviposition site tend to separate into groups of roughly equal egg development, and as oviposition is completed by successive batches of females, the locusts emigrate from whole patches of the area originally covered. The period from the formation of a compact swarm at the oviposition site to the end of oviposition was 7–10 days, and oviposition began not later than the second day. The locusts leaving the area were at first mostly males, but towards the end of the oviposition period they included a large proportion of females. The locusts did not leave as a coherent swarm, and except for temporary aggregations for feeding, swarms were not formed again until the locusts congregated once more for oviposition. Marked locusts were recovered only with difficulty during this period of dispersal, but were found with ease among the congregating individuals some days later. Most marked locusts were recovered about 50 miles from the area where the spray was applied, but owing to their scattered emigration from the egg-bed no information was obtained as to the route followed or the distance actually flown. One marked locust was recovered at a point 90 miles away after 30 days. All recoveries of marked locusts were made to the east or south-east of the area where they were marked, and the winds in the intervening period were predominantly from the west. There was some evidence that the period elapsing between successive depositions of egg pods was 16–20 days during early winter.

The results indicate that control operations against ovipositing swarms are best performed as soon as the females are observed making trial holes in the soil; this occurs on the first day of aggregation, and numbers are then at a maximum. If this policy is adopted, campaigns against the hoppers need be directed only against the largest bands, since the adults that develop from the smaller ones can be destroyed economically and effectively on the oviposition sites by means of aircraft or other power equipment.

Matthée (J. J.). **The Production of Diapause Eggs by incipient Swarms of *Locustana pardalina* (Walk.).**—*J. ent. Soc. S. Afr.* **16** no. 2 pp. 132–138, 6 refs. Pretoria, 1953.

The following is based largely on the author's summary. An account is given of incubation experiments with eggs of *Locusta pardalina* (Wlk.) collected in 1951 in the outbreak area of this locust in South Africa. The majority of the eggs (95–100 per cent.) were in diapause, showing that the

eggs produced by females in incipient swarms such as had just formed may enter diapause to the same degree as those laid by individuals in phases *solitaria* and *transiens* reared in the laboratory [*cf. R.A.E.*, A **42** 34]. As the egg stage is the determining factor influencing fluctuations in population, the presence of diapause eggs complicates the forecasting of hopper outbreaks, especially those of the second and third generations, since diapause eggs of previous generations may still be present. Outbreaks of first-generation hoppers are less affected, since the diapause is eliminated during the dry, cold weather that precedes the spring rains.

Spraying or dusting the ovipositing females with BHC did not reduce the viability of the eggs laid, and no evidence was obtained that sufficient BHC penetrated or was washed into the soil to affect them.

Dirsh (V. M.). **Morphometrical Studies on Phases of the Desert Locust (*Schistocerca gregaria* Forskål).**—*Anti-Locust Bull.* no. 16 [4 + ] 34 pp., 31 figs., 13 refs. London, 1953.

Statistical studies of various measurable characters of *Schistocerca gregaria* (Forsk.) were made in an attempt to determine reliable criteria by which adults in the morphologically extreme phases *gregaria* and *solitaria* could be readily separated. Direct measurements proved unsatisfactory, even eight that varied in the same way in both sexes, which included the length of the hind femur (F), the maximum width of the head in the genal region (C) and the width of the vertex between the eyes (V), showing considerable overlapping in frequency distribution. Ratios proved superior, but of seven between measurements that varied in the same direction in the two sexes and in opposite directions according to phase, only the F/C and F/V ratios showed no overlapping. These two were therefore the most suitable, and as C is more easily measured than V in the field, the F/C ratio is recommended. The E/F ratio commonly used [*cf. R.A.E.*, A **31** 156] is less satisfactory, because E (the length of the elytron) varies in different directions in the two sexes.

It is proposed that the modal values for the F/C ratio should be adopted as the limiting values for pure *gregaria* and *solitaria*, males and females showing values of up to 3·15 thus being considered as morphologically pure *gregaria*, those showing values of at least 3·75 and 3·85, respectively, as pure *solitaria*, and those with intermediate values as *transiens*. Based on these figures, a percentage of gregarisation (PG) can be calculated for a whole population or even one individual, and tables are given showing the percentages corresponding to the various F/C and E/F ratios.

Tindale (N. B.). **On a new Species of *Oenetus* (Lepidoptera, Family Hepialidae) damaging *Eucalyptus* Saplings in Tasmania.**—*Trans. roy. Soc. S. Aust.* **76** pp. 77–79, 1 pl. Adelaide, 1953.

The following is substantially the author's summary. A new Hepialid, *Oenetus paradiseus*, sp.n., is described from adults collected in Tasmania, where it was found causing some damage to *Eucalyptus* saplings. The harm is accentuated by the injuries caused to the wood by black cockatoos (*Calyptorhynchus funereus*) while they are feeding on the larvae and pupae. Interaction of moth and cockatoo evidently plays an important part in the natural culling of sapling *Eucalyptus*. *O. paradiseus* subsp. *montanus*, n., is described from snow gums (*Eucalyptus niphophila*) on Mt. Gingera in the Federal Capital Territory, where the larvae and pupae were also attacked by cockatoos.

## INDEX OF AUTHORS

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